ELECTRA

# Service Manual

## DUO 38 DCI / DELTA

| Indoor Units | Outdoor Units |
|---|---|
| DELTA 22 | DUO 38 DCI |
| DELTA 25 | |
| DELTA 35 | |

**REFRIGERANT**

**R410A**

**HEAT PUMP**

SM DUO38 1-E.1 GB

SEPTEMBER – 2008

CONTENT

# LIST OF EFFECTIVE PAGES

**Note:** Changes in the pages are indicated by a “Revision#” in the footer of each effected page (when none indicates no changes in the relevant page). All pages in the following list represent effected/ non effected pages divided by chapters.

Dates of issue for original and changed pages are:

Original ..... 0 ..... January 2006

Total number of pages in this publication is 56 consisting of the following:

| Page No. | Revision No. # | | Page No. | Revision No. # | | Page No. | Revision No. # |
|---|---|---|---|---|---|---|---|

Title ..... 1
A ..... 1
i ..... 1
1-1 ..... 1
2-1 - 2-4 ..... 1
3-1 - 3-1 ..... 1
4-1 - 4-2 ..... 1
5-1 - 5-9 ..... 1
6-1 - 6-2 ..... 1
7-1 ..... 1
8-1 ..... 1
9-1 - 9-2 ..... 1
10-1 ..... 1
11-1-11-18..... 1
12-1-12-6 ..... 1
13-1-13-2 ..... 1
Appendix -A .....1

- Zero in this column indicates an original page.

*Due to constant improvements please note that the data on this service manual can be modified with out notice.
**Photos are not contractual

# Table of Contents

1. INTRODUCTION .....1-1

2. PRODUCT DATA SHEET .....2-1

3. RATING CONDITIONS .....3-1

4. OUTLINE DIMENSIONS .....4-1

5. PERFORMANCE DATA .....5-1

6. PRESSURE CURVES .....6-1

7. ELECTRICAL DATA .....7-1

8. WIRING DIAGRAMS .....8-1

9. REFRIGERATION DIAGRAMS .....9-1

10. TUBING CONNECTIONS .....10-1

11. CONTROL SYSTEM .....11-1

12. TROUBLESHOOTING .....12-1

13. EXPLODED VIEWS AND SPARE PARTS LISTS .....13-1

14. APPENDIX A .....14-1

# 1. INTRODUCTION

## 1.1 General

The new DUO 3.8 DCI Outdoor Unit is a high efficiency multi split inverter unit, supporting Indoor Units capacity range of - 2.2, 2.5 and 3.5 Kw.

## 1.2 Main Features

- DC Inverter
- R410A
- High COP (A class energy rating)
- Pre-Charged
- Base heater connection.
- Cooling operation at outdoor temperature down to -10$^0$C.
- Heating operation at outdoor temperature down to -15$^0$C.
- 10 LED's, shows both indoor and outdoor diagnostics.
- Variable Speed DC Inverter outdoor fan.
- M2L diagnostics softwear cable Port ( for PC).
- Low noise level

## 1.3 Tubing Connections

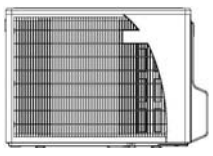
Flare type interconnecting tubing to be produced on site.
For further details please refer to APPENDIX A on this manual, and to the relevant indoor service Manual,

## 1.4 Inbox Documentation

Each indoor unit is supplied with its own installation and operation manuals.

## 1.5 Matching Table

### 1.5.1 R410A

| | | | INDOOR UNITS | | |
|---|---|---|---|---|---|
| OUTDOOR UNITS | | | | | |
|  | MODEL | REFRIGERANT | DELTA 22 DCI | DELTA 25 DCI | DELTA 35 DCI |
| | DUO 38 DCI | R410A | √ | √ | √ |

# 2. PRODUCT DATA SHEET

## 2.1 Outdoor Unit DUO 38 DCI / Delta Specifications.

| | | | | | |
|---|---|---|---|---|---|
| Model Indoor Unit | | | | **DELTA 22 25 35** | |
| Model Outdoor Unit | | | | **DCI DUO Delta 38 R410A** | |
| Installation Method of Pipe | | | | Flared | |
| **Characteristics** | | | **Units** | **Cooling** | **Heating** |
| Capacity (4)) | | | Btu/hr | 13300(4090-18750) | 15350(4090-21140) |
| | | | kW | 3.90(**1.50**-5.50) | 4.50(1.20-6.20) |
| Power input (4) | | | kW | 1.1(0.45-1.80) | 1.24(0.45-1.80) |
| EER (Cooling) or COP(Heating) (4) | | | W/W | 3.55 | 3.61 |
| Energy efficiency class | | | | A | A |
| Power supply | | | V/Ph/Hz | 220-240V/Single/50Hz | |
| Rated current | | | A | 4.8 | 5.4 |
| Starting current | | | A | 10.5 | |
| Circuit breaker rating | | | A | 15 | |
| OUTDOOR | Refrigerant control | | | EEV | |
| | Compressor type,model | | | Single Rotary DC Inverter,Panasonic 5RS102XAB | |
| | Fan type & quantity | | | Propeller(direct) x 1 | |
| | Fan speeds | H/L | RPM | 920/500 | |
| | Air flow | H/L | m3/hr | 2160 | |
| | Sound power level | H/L | dB(A) | 62 | 63 |
| | Sound pressure level (3) | H/L | dB(A) | 52 | 53 |
| | Dimensions | WxHxD | mm | 795*290*610 | |
| | Weight | | kg | 38 | |
| | Package dimensions | WxHxD | mm | 945*395*655 | |
| | Packaged weight | | kg | 40 | |
| | Units per pallet | | Units | 9 units per pallet | |
| | Stacking height | | units | 3 levels | |
| | Refrigerant type | | | R410A | |
| | Refrigerant chargless distance | | kg/m | 1.2/7.5 | |
| | Additional charge per 1 meter | | g/m | No need | |
| | Connections between units | Liquid line | In.(mm) | 1/4"(6.35) | |
| | | Suction line | In.(mm) | 3/8"(9.53) | |
| | | Max.tubing length | m. | Max.30 | |
| | | Max.height difference | m. | Max. 10 | |
| Operation control type | | | | Remote control | |
| Heating elements | | | kW | | |
| Others | | | | | |

(1)Airflow in ducted units;at nominal external static pressure.
(2)Sound power in ducted units is measured at air discharge.
(3)Sound pressure level measured at 1-meter distance from unit.
(4)Rating conditions in accordance to ISO 5151 and ISO 13253 (for ducted units).

## 2.2 Indoor Units Data

### 2.2.1 DELTA 22 DCI Specifications

| | | | | | | |
|---|---|---|---|---|---|---|
| Model Indoor Unit / Type | | | | **DELTA 22 DCI / Wall Mounted** | | |
| Installation Method | | | | FLARE | | |
| Power Supply | | | V/Ph/Hz | 220-240 / 1/ 50 | | |
| INDOOR | Fan Type & Quantity | | | Crossflow *1 | | |
| | Airflow(2) Cooling / Heating | H/M/L | $m^3$/hr | 400 | 350 | 300 |
| | Sound Power Level(3) Cooling / Heating | L - H | dB (A) | 49/46/43 | | |
| | Sound Pressure Level (4) Cooling / Heating | L - H | dB (A) | 36/33/30 | | |
| | Condensate Drain Tube I.D. | | mm | 16 | | |
| | Dimensions | W/H/D | mm | 680 | 250 | 185 |
| | Weight | | kg | 7 | | |
| | Package Dimensions | W/H/D | mm | 740 | 320 | 265 |
| | Stacking Height | | Units | 9 LEVELS | | |
| Heating Elements | | | kW | N/A | | |
| Moisture Removal | | | L/hr | 1 | | |

### 2.2.2 DELTA 25 DCI Specifications

| | | | | | | |
|---|---|---|---|---|---|---|
| Model Indoor Unit / Type | | | | **DELTA 25 DCI / Wall Mounted** | | |
| Installation Method | | | | FLARE | | |
| Power Supply | | | V/Ph/Hz | 220-240 / 1/ 50 | | |
| INDOOR | Fan Type & Quantity | | | Crossflow *1 | | |
| | Airflow(2) Cooling / Heating | H/M/L | $m^3$/hr | 420 | 350 | 270 |
| | Sound Power Level(3) Cooling / Heating | L - H | dB (A) | 52/48/45 | | |
| | Sound Pressure Level (4) Cooling / Heating | L - H | dB (A) | 39/35/32 | | |
| | Condensate Drain Tube I.D. | | mm | 16 | | |
| | Dimensions | W/H/D | mm | 680 | 250 | 185 |
| | Weight | | kg | 7 | | |
| | Package Dimensions | W/H/D | mm | 740 | 320 | 260 |
| | Stacking Height | | Units | 9 LEVELS | | |
| Heating Elements | | | kW | N/A | | |
| Moisture Removal | | | L/hr | 1.0 | | |

(1) Rating conditions in accordance with ISO 5151 and ISO 13253 (for ducted units) and EN14511.
(2) Airflow in ducted units; at nominal external static pressure.
(3) Sound power in ducted units is measured at air discharge.
(4) Sound pressure level measured at 1 meter distance from unit.

### 2.2.3 DELTA 35 DCI Specifications

| | | | | | | |
|---|---|---|---|---|---|---|
| Model Indoor Unit / Type | | | | **DELTA 35 DCI / Wall Mounted** | | |
| Installation Method | | | | FLARE | | |
| Power Supply | | | V/Ph/Hz | 220-240 / 1/ 50 | | |
| INDOOR | Fan Type & Quantity | | | Crossflow *1 | | |
| | Airflow(2) Cooling / Heating | H/M/L | $m^3$/hr | 550 | 450 | 350 |
| | Sound Power Level(3) Cooling / Heating | L - H | dB (A) | 56/46/42 | | |
| | Sound Pressure Level (4) Cooling / Heating | L - H | dB (A) | 39/33/29 | | |
| | Condensate Drain Tube I.D. | | mm | 16 | | |
| | Dimensions | W/H/D | mm | 840 | 250 | 185 |
| | Weight | | kg | 8.0 | | |
| | Package Dimensions | W/H/D | mm | 930 | 320 | 265 |
| | Stacking Height | | Units | 9 LEVELS | | |
| Heating Elements | | | kW | N/A | | |
| Moisture Removal | | | L/hr | 1.5 | | |

(1) Rating conditions in accordance with ISO 5151 and ISO 13253 (for ducted units) and EN14511.
(2) Airflow in ducted units; at nominal external static pressure.
(3) Sound power in ducted units is measured at air discharge.
(4) Sound pressure level measured at 1 meter distance from unit.

## 2.3 Indoor Units Combinations

| Indoor Units Combinations | Cooling | | | | Heating | | | |
|---|---|---|---|---|---|---|---|---|
| | Room A [W] | Room B [W] | Total Capacity [W] | Power Input [W] | Room A [W] | Room B [W] | Total Capacity [W] | Power Input [W] |
| 22 | 2200 | - | 2200 (1500 - 2600) | 675 (450 - 850) | 2500 | - | 2500 (1200 - 3100) | 750 (450 - 1000) |
| 25 | 2500 | - | 2500 (1500 - 3000) | 750 (450 - 980) | 2800 | - | 2800 (1200 – 3500) | 910 (450 – 1220) |
| 35 | 3500 | - | 3500 (1500 - 4100) | 1030 (450 – 1250) | 3600 | - | 3600 (1200 - 4100) | 1030 (450 - 1150) |
| 22+22 | 1850 | 1850 | 3700 (1500 - 4700) | 1000 (450-1800) | 2150 | 2150 | 4300 (1200 – 5200) | 1200 (450 – 1800) |
| 22+25 | 1850 | 1950 | 3800 (1500 - 4800) | 1050 (450 - 1800) | 2150 | 2250 | 4400 (1200 – 5300) | 1240 (450 – 1800) |
| 22+35 | 1850 | 3050 | 4900 (1500 - 5200) | 1350 (450 - 1800) | 2150 | 3250 | 5400 (1200 – 5900) | 1520 (450 – 1800) |
| 25+25 | 1950 | 1950 | 3900 (1500 - 5500) | 1100 (450 - 1800) | 2250 | 2250 | 4500 (1200 - 6200) | 1280 (450 - 1800) |
| 25+35 | 1950 | 3050 | 5000 (1500 - 5500) | 1400 (450 - 1800) | 2250 | 3250 | 5500 (1200 - 6200) | 1560 (450 - 1800) |

# 3. RATING CONDITIONS

Standard conditions in accordance with ISO 5151, ISO 13253 (for ducted units) and EN 14511.

**Cooling:**
Indoor: 27°C DB 19°C WB
Outdoor: 35 °C DB

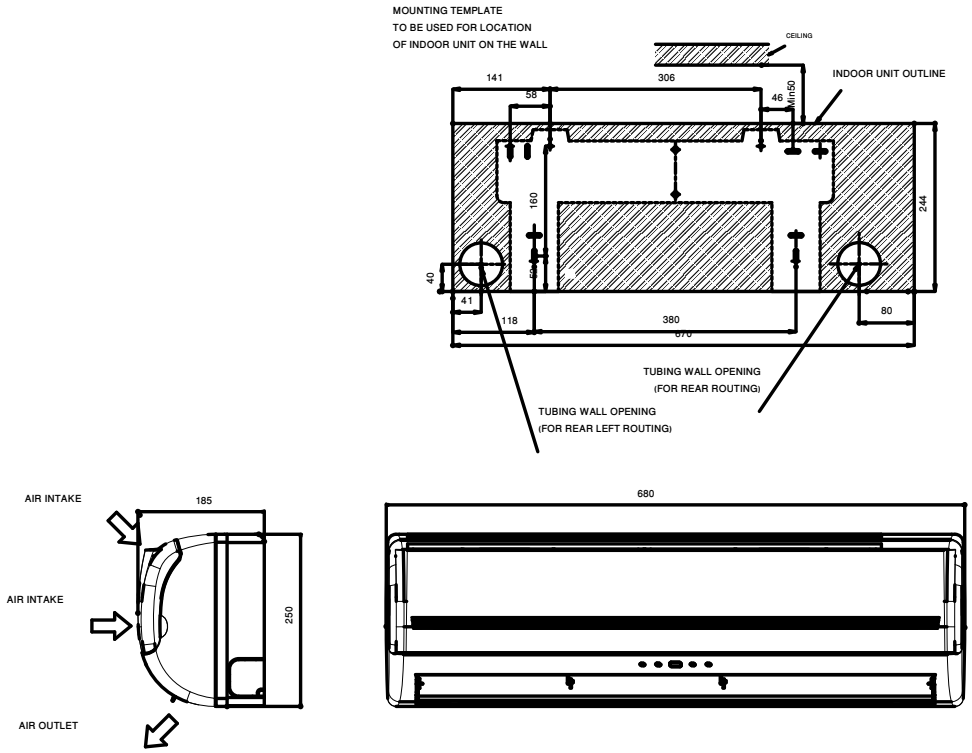
**Heating:**
Indoor: 20°C DB
Outdoor: 7°C DB 6°C WB

## 3.1 Operating Limits

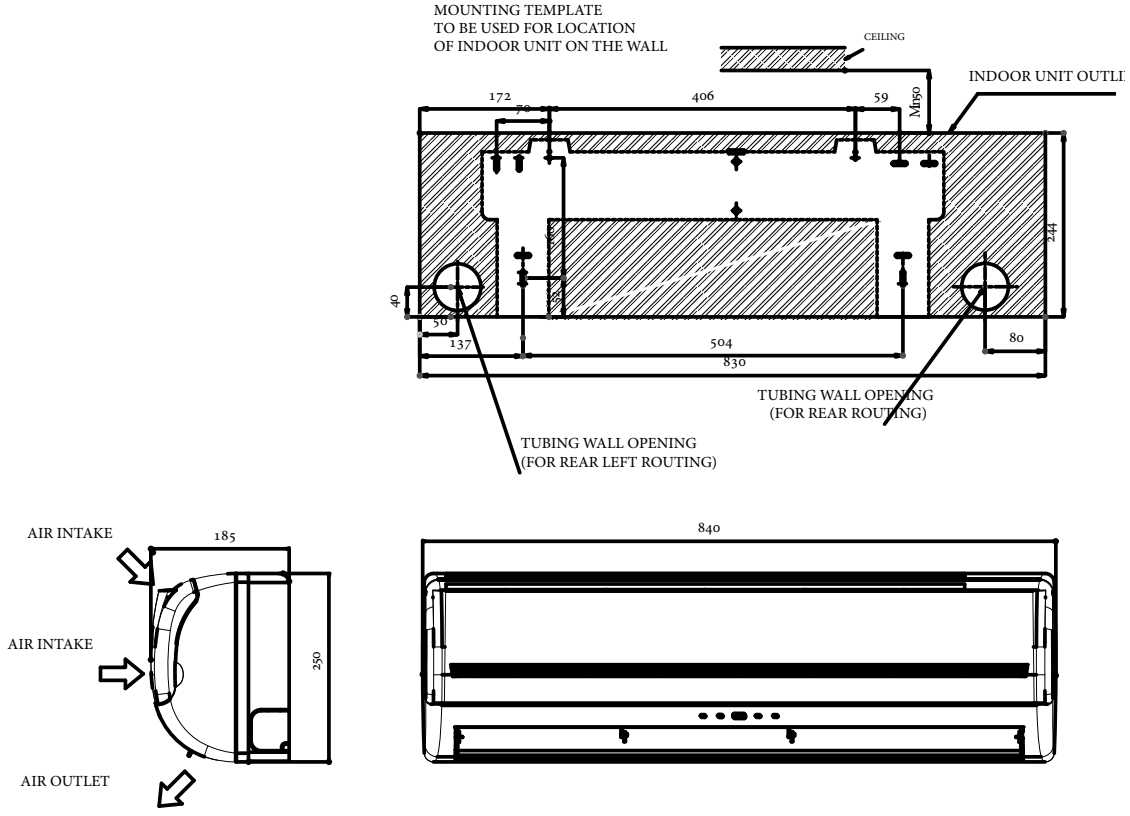
| | | Indoor | Outdoor |
|---|---|---|---|
| **Cooling** | Upper limit | 32°C DB 23°C WB | 46°C DB |
| | Lower limit | 21°C DB 15°C WB | -10°C DB |
| **Heating** | Upper limit | 27°C DB | 24°C DB 18°C WB |
| | Lower limit | 10°C DB | -15°C DB -16°C WB |
| **Voltage** | 1PH | 198 – 264 V | |
| | 3PH | N/A | |

# 4. OUTLINE DIMENSIONS

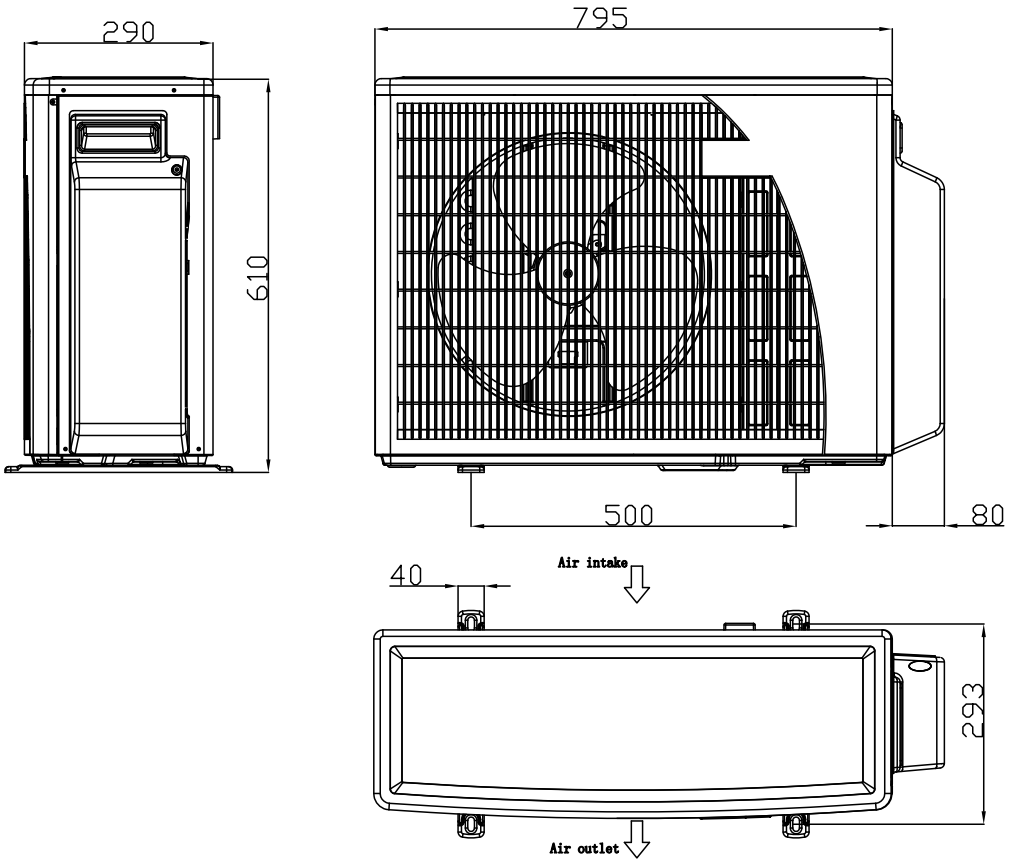
## 4.1 Indoor Unit: DELTA 22, DELTA 25 DCI




## 4.2 Indoor Unit: DELTA 35 DCI



## 4.3 Outdoor Unit: DUO 38 DCI / Delta



# 5. PERFORMANCE DATA

## 5.1 Delta 22+22 DCI

### 5.1.1 Cooling Capacity (kW) - Run Mode (Unit A or B)

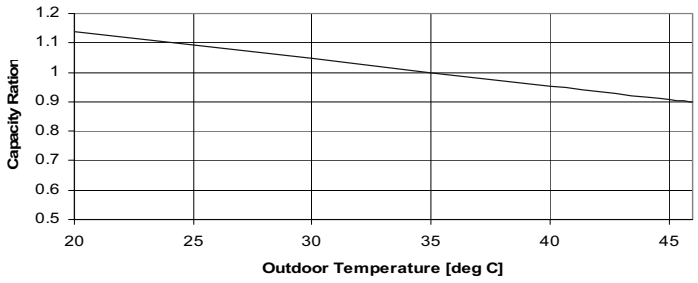
**230[V] : Indoor Fan at High Speed.**

| | | ID COIL ENTERING AIR DB/WB TEMPERATURE [0C] | | | | |
|---|---|---|---|---|---|---|
| **OD COIL ENTERING AIR DB TEMPERATURE [0C]** | **DATA** | **22/15** | **24/17** | **27/19** | **29/21** | **32/23** |
| **-10 - 20 (protection range)** | TC | 80 - 110 % of nominal | | | | |
| | SC | 80 - 105 % of nominal | | | | |
| | PI | 25 - 50 % of nominal | | | | |
| **25** | TC | 1.98 | 2.10 | 2.22 | 2.33 | 2.45 |
| | SC | 1.53 | 1.57 | 1.61 | 1.64 | 1.68 |
| | PI | 0.39 | 0.40 | 0.41 | 0.42 | 0.43 |
| **30** | TC | 1.80 | 1.92 | 2.03 | 2.15 | 2.26 |
| | SC | 1.46 | 1.49 | 1.53 | 1.56 | 1.60 |
| | PI | 0.44 | 0.45 | 0.45 | 0.46 | 0.47 |
| **35** | TC | 1.62 | 1.73 | **1.85** | 1.97 | 2.08 |
| | SC | 1.38 | 1.41 | **1.45** | 1.49 | 1.52 |
| | PI | 0.48 | 0.49 | **0.50** | 0.51 | 0.52 |
| **40** | TC | 80%-92% of nominal | | | | |
| | SC | 80%-92% of nominal | | | | |
| | PI | 80%-100% of nominal | | | | |
| **46** | TC | 70%-85% of nominal | | | | |
| | SC | 70%-85% of nominal | | | | |
| | PI | 90%-100% of nominal | | | | |

**LEGEND**

TC – Total Cooling Capacity, kW
SC – Sensible Capacity, kW
PI – Power Input, kW
WB – Wet Bulb Temp., (°C)
DB – Dry Bulb Temp., (°C)
ID – Indoor
OD – Outdoor

### 5.1.2 Capacity Correction Factors



### 5.1.3 Heating Capacity (kW) - Run Mode(Unit A or B)

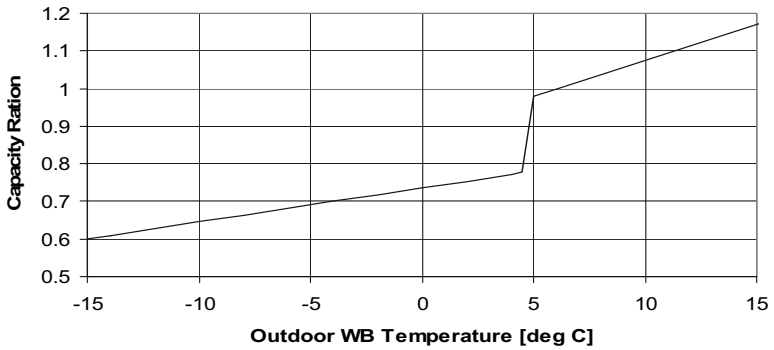
**230[V] : Indoor Fan at High Speed.**

| OD COIL ENTERING AIR DB/WB TEMPERATURE [C$^0$] | DATA | ID COIL ENTERING AIR DB TEMPERATURE [C$^0$] | | |
|---|---|---|---|---|
| | | 15 | 20 | 25 |
| -15/-16 | TC | 1.15 | 1.07 | 1.00 |
| | PI | 0.38 | 0.44 | 0.49 |
| -10/-12 | TC | 1.37 | 1.30 | 1.23 |
| | PI | 0.44 | 0.50 | 0.55 |
| -7/-8 | TC | 1.54 | 1.47 | 0.55 |
| | PI | 0.49 | 0.54 | 0.60 |
| -1/-2 | TC | 1.63 | 1.56 | 1.49 |
| | PI | 0.51 | 0.56 | 0.62 |
| 2/1 | TC | 1.68 | 1.61 | 1.54 |
| | PI | 0.52 | 0.58 | 0.63 |
| 7/6 | TC | 2.22 | **2.15** | 2.08 |
| | PI | 0.54 | **0.60** | 0.66 |
| 10/9 | TC | 2.31 | 2.24 | 2.17 |
| | PI | 0.57 | 0.63 | 0.68 |
| 15/12 | TC | 2.40 | 2.33 | 2.26 |
| | PI | 0.60 | 0.65 | 0.71 |
| 15-24 (Protection Range) | TC | 85 - 105 % of nominal | | |
| | PI | 80 - 120 % of nominal | | |

**LEGEND**

TC – Total Cooling Capacity, kW
PI – Power Input, kW
WB – Wet Bulb Temp., (°C)
DB – Dry Bulb Temp., (°C)
ID – Indoor
OD – Outdoor

### 5.1.4 Capacity Correction Factors



## 5.2 Delta 25+25 DCI

### 5.2.1 Cooling Capacity (kW) - Run Mode (Unit A or B)

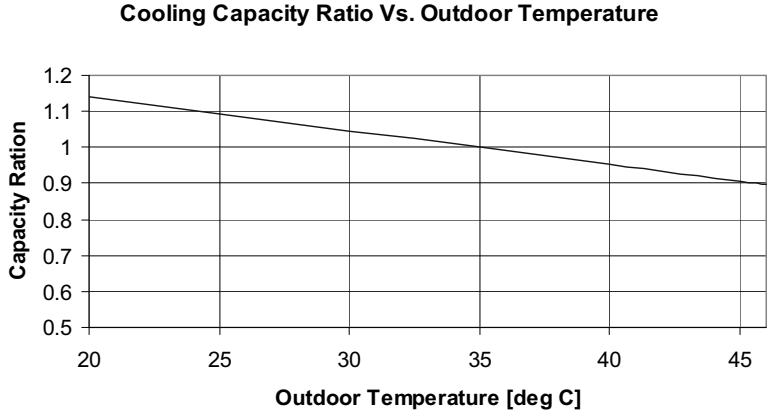
**230[V] : Indoor Fan at High Speed.**

| OD COIL ENTERING AIRDB TEMPERATURE [°C] | DATA | ID COIL ENTERING AIR DB/WB TEMPERATURE [0C] | | | | |
|---|---|---|---|---|---|---|
| | | 22/15 | 24/17 | 27/19 | 29/21 | 32/23 |
| -10 - 20 (protection range) | TC | 80 - 110 % of nominal | | | | |
| | SC | 80 - 105 % of nominal | | | | |
| | PI | 25 - 50 % of nominal | | | | |
| 25 | TC | 2.09 | 2.21 | 2.34 | 2.46 | 2.58 |
| | SC | 1.64 | 1.68 | 1.72 | 1.76 | 1.80 |
| | PI | 0.43 | 0.44 | 0.45 | 0.46 | 0.47 |
| 30 | TC | 1.90 | 2.02 | 2.14 | 2.27 | 2.39 |
| | SC | 1.56 | 1.59 | 1.63 | 1.67 | 1.71 |
| | PI | 0.48 | 0.49 | 0.50 | 0.51 | 0.52 |
| 35 | TC | 1.71 | 1.83 | **1.95** | 2.07 | 2.19 |
| | SC | 1.47 | 1.51 | **1.55** | 1.59 | 1.63 |
| | PI | 0.53 | 0.54 | **0.55** | 0.56 | 0.57 |
| 40 (protection range | TC | 80%-92% of nominal | | | | |
| | SC | 80%-92% of nominal | | | | |
| | PI | 80%-100% of nominal | | | | |
| 46 (protection range | TC | 70%-85% of nominal | | | | |
| | SC | 70%-85% of nominal | | | | |
| | PI | 90%-100% of nominal | | | | |

**LEGEND**

TC – Total Cooling Capacity, kW
SC – Sensible Capacity, kW
PI – Power Input, kW
WB – Wet Bulb Temp., (°C)
DB – Dry Bulb Temp., (°C)
ID – Indoor
OD – Outdoor

### 5.2.2 Capacity Correction Factors



### 5.2.3 Heating Capacity (kW) - Run Mode(Unit A or B)

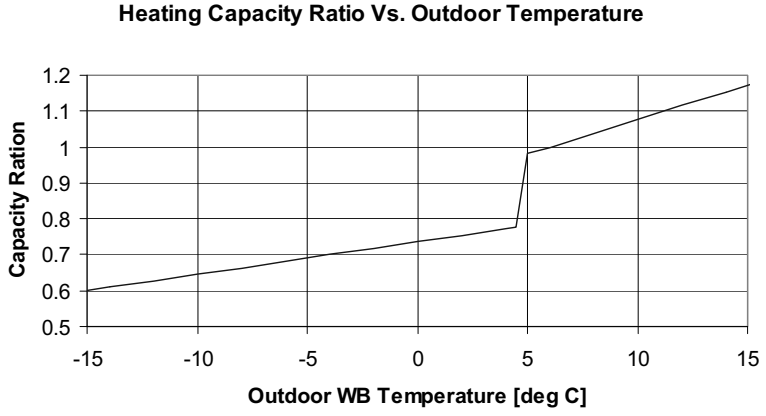
**230[V] : Indoor Fan at High Speed.**

| | | ID COIL ENTERING AIR DB TEMPERATURE [°C] | | |
|---|---|---|---|---|
| **OD COIL ENTERING AIR DB/WB TEMPERATURE [°C]** | **DATA** | **15** | **20** | **25** |
| **-15/-16** | TC | 1.20 | 1.12 | 1.05 |
| | PI | 0.41 | 0.47 | 0.53 |
| **-10/-12** | TC | 1.44 | 1.36 | 1.29 |
| | PI | 0.47 | 0.53 | 0.59 |
| **-7/-8** | TC | 1.61 | 1.54 | 1.47 |
| | PI | 0.52 | 0.58 | 0.64 |
| **-1/-2** | TC | 1.70 | 1.63 | 1.55 |
| | PI | 0.54 | 0.60 | 0.66 |
| **2/1** | TC | 1.76 | 1.69 | 1.61 |
| | PI | 0.56 | 0.62 | 0.68 |
| **7/6** | TC | 2.32 | 2.25 | 2.18 |
| | PI | 0.58 | 0.64 | 0.70 |
| **10/9** | TC | 2.42 | 2.34 | 2.27 |
| | PI | 0.61 | 0.67 | 0.73 |
| **15/12** | TC | 2.51 | 2.43 | 2.36 |
| | PI | 0.64 | 0.69 | 0.75 |
| **15-24 (Protection Range)** | TC | 85 - 105 % of nominal | | |
| | PI | 80 - 120 % of nominal | | |

**LEGEND**

TC – Total Cooling Capacity, kW
PI – Power Input, kW
WB – Wet Bulb Temp., (°C)
DB – Dry Bulb Temp., (°C)
ID – Indoor
OD – Outdoor

### 1.3.4 Capacity Correction Factors



## 5.3 Delta 25+35

### 5.3.1 Cooling Capacity (kW) - Run Mode(Unit A or B)

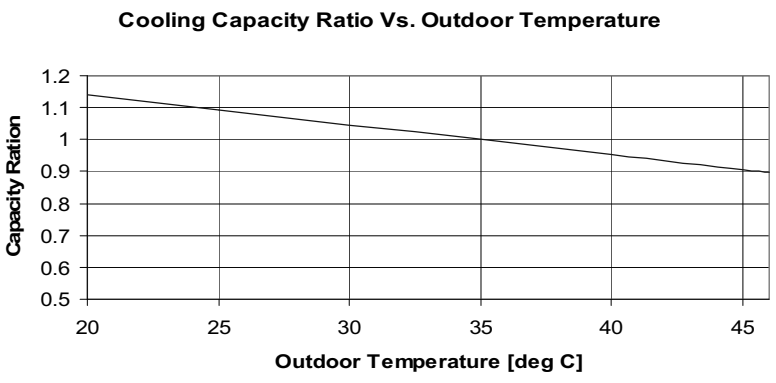
**230[V] : Indoor Fan at High Speed.**

| OD COIL ENTERING AIR DB TEMPERATURE [°C] | DATA | ID COIL ENTERING AIR DB/WB TEMPERATURE [°C] 22/15 | 24/17 | 27/19 | 29/21 | 32/23 |
|---|---|---|---|---|---|---|
| -10 - 20 (protection range) | TC | 80 - 110 % of nominal | | | | |
| | SC | 80 - 105 % of nominal | | | | |
| | PI | 25 - 50 % of nominal | | | | |
| 25 | TC | 3.27 | 3.46 | 3.65 | 3.84 | 4.04 |
| | SC | 2.22 | 2.27 | 2.33 | 2.38 | 2.43 |
| | PI | 0.67 | 0.68 | 0.70 | 0.71 | 0.72 |
| 30 | TC | 2.97 | 3.16 | 3.35 | 3.54 | 3.73 |
| | SC | 2.11 | 2.16 | 2.21 | 2.27 | 2.32 |
| | PI | 0.75 | 0.76 | 0.77 | 0.79 | 0.80 |
| 35 | TC | 2.67 | 2.86 | **3.05** | 3.24 | 3.43 |
| | SC | 1.99 | 2.05 | **2.10** | 2.15 | 2.21 |
| | PI | 0.82 | 0.84 | **0.85** | 0.86 | 0.88 |
| 40 | TC | 80%-92% of nominal | | | | |
| | SC | 80%-92% of nominal | | | | |
| | PI | 80%-100% of nominal | | | | |
| 46 | TC | 70%-85% of nominal | | | | |
| | SC | 70%-85% of nominal | | | | |
| | PI | 90%-100% of nominal | | | | |

**LEGEND**

TC – Total Cooling Capacity, kW
SC – Sensible Capacity, kW
PI – Power Input, kW
WB – Wet Bulb Temp., (°C)
DB – Dry Bulb Temp., (°C)
ID – Indoor
OD – Outdoor

### 5.3.2 Capacity Correction Factors



### 5.3.3 Heating Capacity (kW) - Run Mode(Unit A or B)

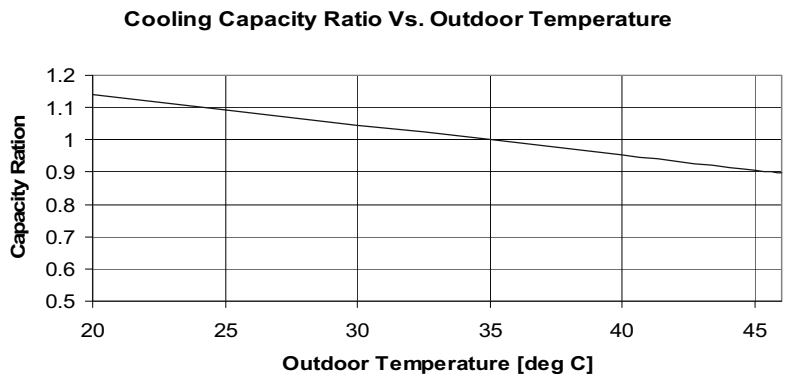
**230[V] : Indoor Fan at High Speed.**

| | | ID COIL ENTERING AIR DB TEMPERATURE [°C] | | |
|---|---|---|---|---|
| **OD COIL ENTERING AIR DB/WB TEMPERATURE [°C]** | **DATA** | **15** | **20** | **25** |
| **-15/-16** | TC | 1.73 | 1.62 | 1.52 |
| | PI | 0.59 | 0.67 | 0.76 |
| **-10/-12** | TC | 2.07 | 1.97 | 1.86 |
| | PI | 0.68 | 0.76 | 0.85 |
| **-7/-8** | TC | 2.33 | 2.22 | 2.12 |
| | PI | 0.75 | 0.83 | 0.91 |
| **-1/-2** | TC | 2.46 | 2.35 | 2.25 |
| | PI | 0.78 | 0.86 | 0.95 |
| **2/1** | TC | 2.55 | 2.44 | 2.33 |
| | PI | 0.80 | 0.89 | 0.97 |
| **7/6** | TC | 3.36 | 3.25 | 3.14 |
| | PI | 0.84 | 0.92 | 1.00 |
| **10/9** | TC | 3.49 | 3.38 | 3.28 |
| | PI | 0.87 | 0.96 | 1.04 |
| **15/12** | TC | 3.62 | 3.52 | 3.41 |
| | PI | 0.91 | 1.00 | 1.08 |
| **15-24 (Protection Range)** | TC | 85 - 105 % of nominal | | |
| | PI | 80 - 120 % of nominal | | |

**LEGEND**

TC – Total Cooling Capacity, kW
PI – Power Input, kW
WB – Wet Bulb Temp., (°C)
DB – Dry Bulb Temp., (°C)
ID – Indoor
OD – Outdoor

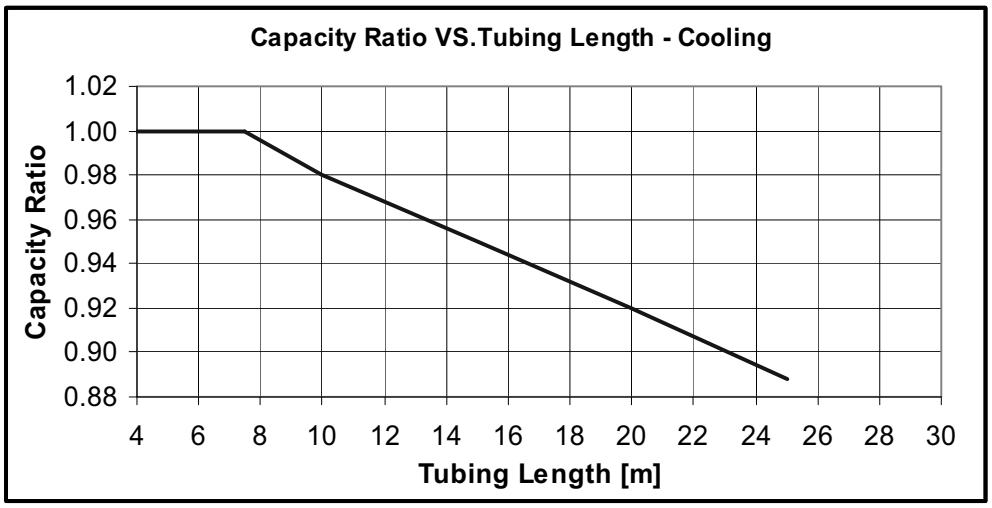
### 5.3.4 Capacity Correction Factors



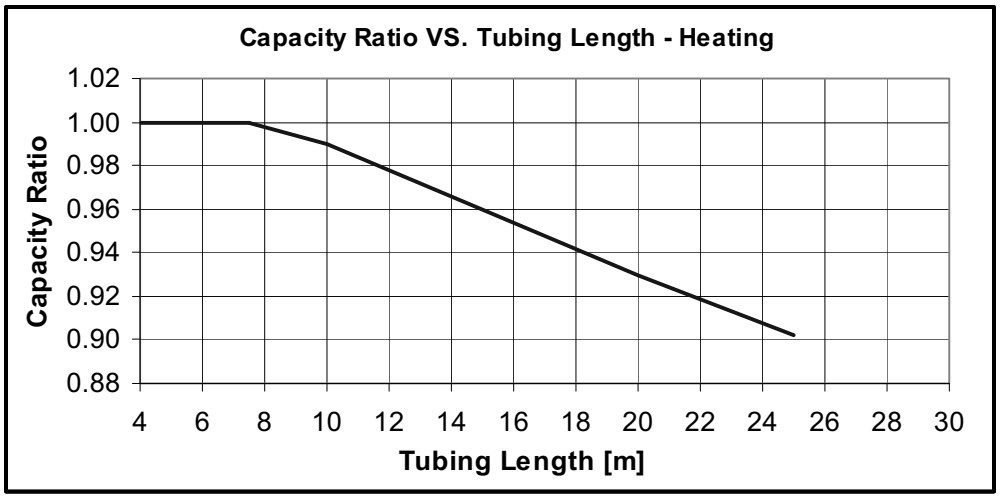
## 5.4 Capacity Correction Factor Due to Tubing Length (OneWay)

### 5.4.1 Delta 22 / 25 / 35 DCI

### 5.4.2 Cooling



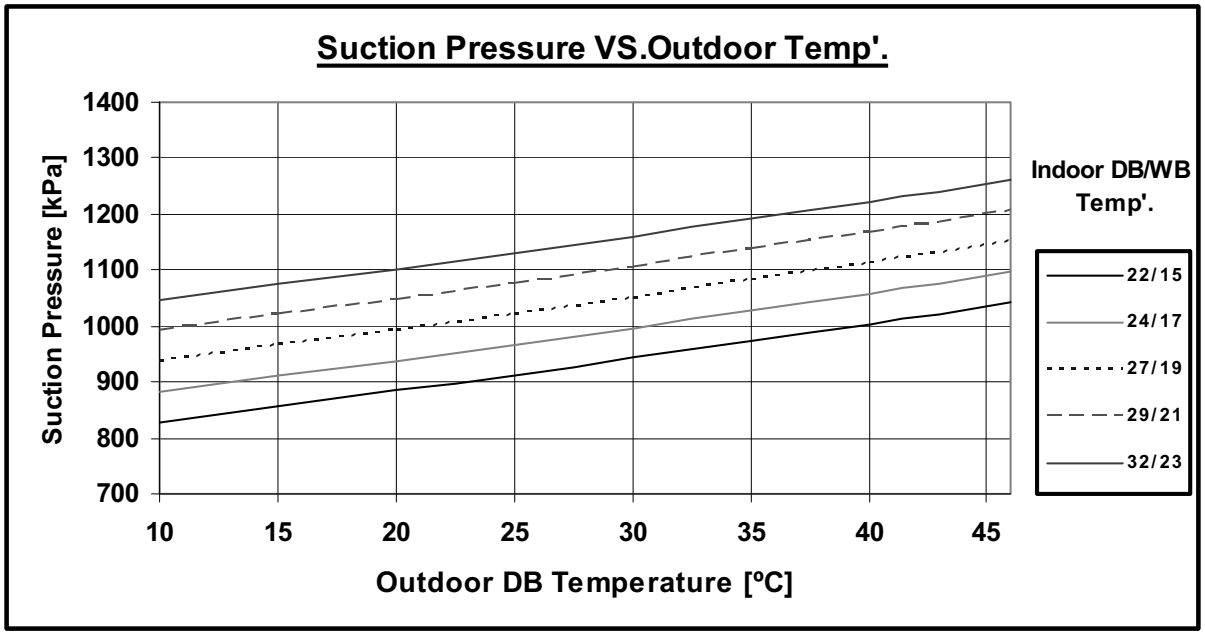

### 5.4.3 Heating

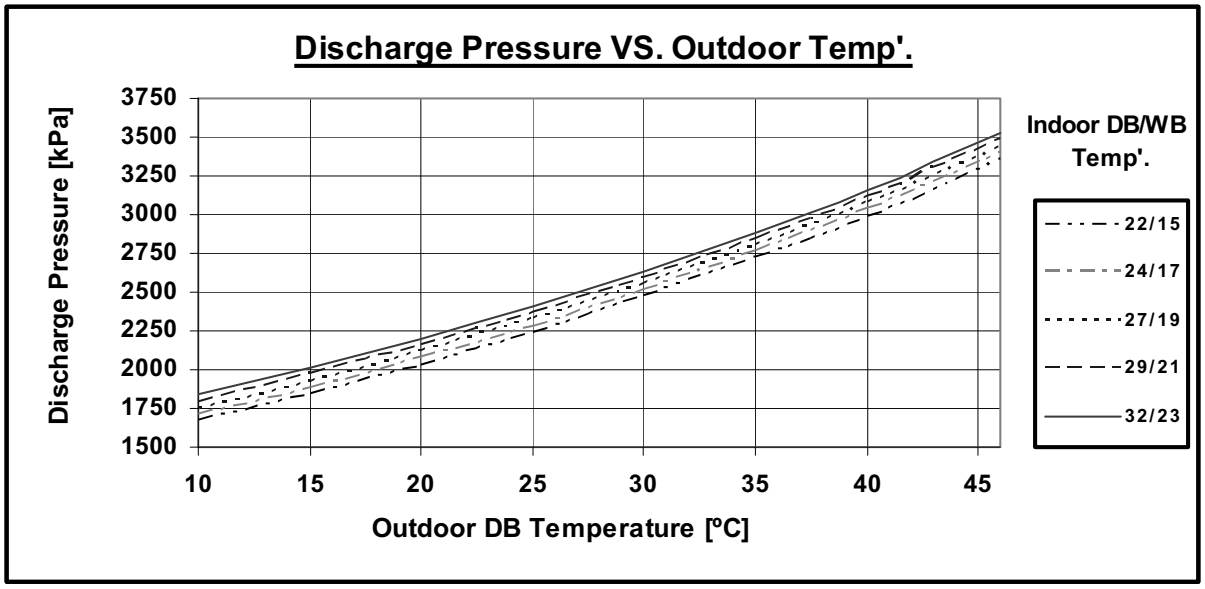


# 6. PRESSURE CURVES

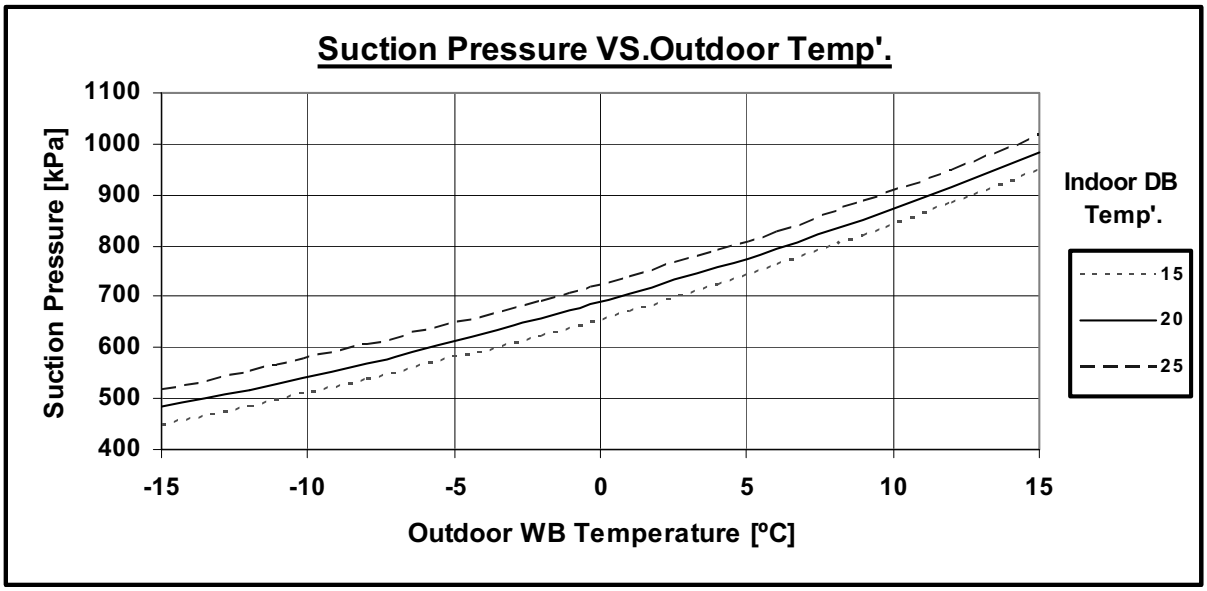
## 6.1 Model: Delta 22+22, Delta 25+25 DUO 38 DCI

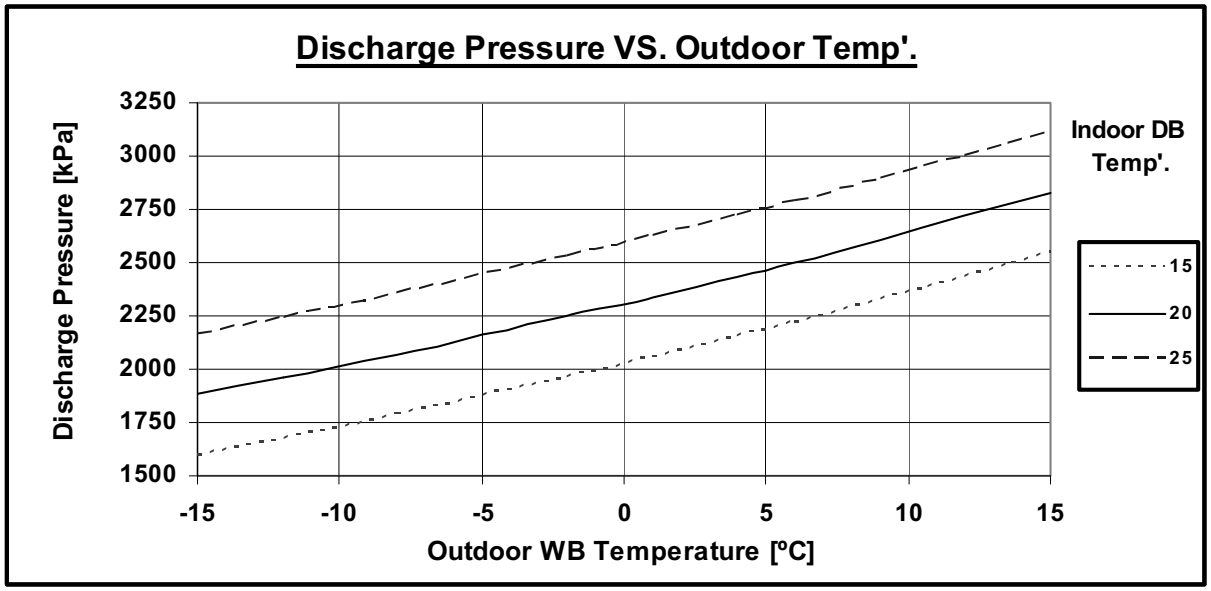
### 6.1.1 Cooling – Test Mode



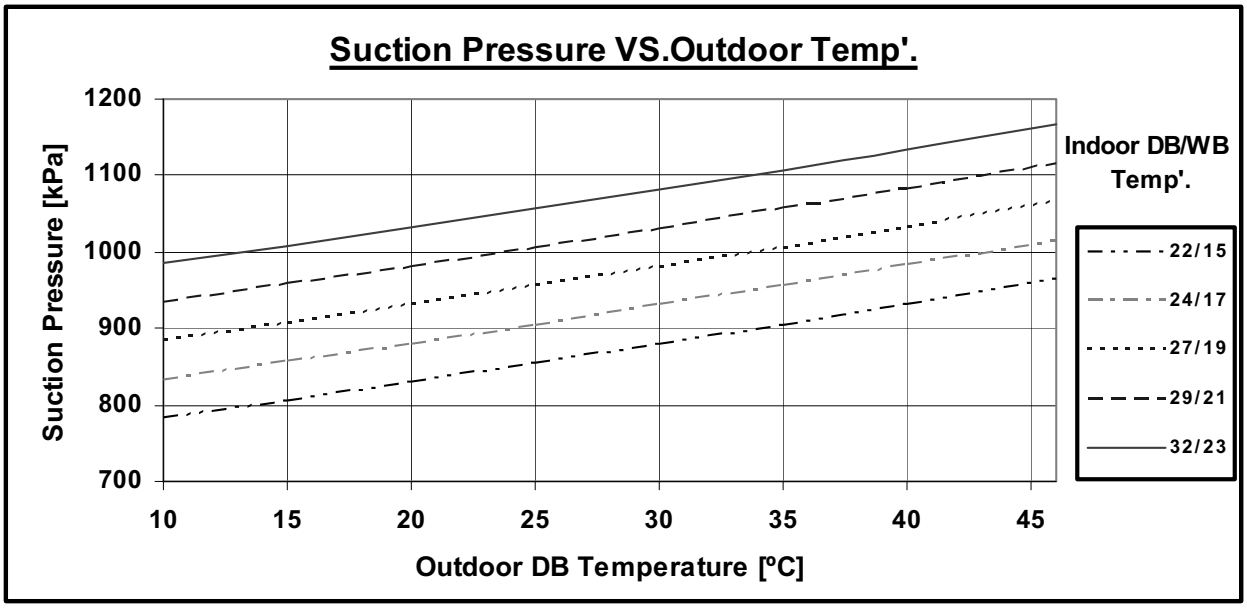
### 6.1.2 Heading – Test Mode

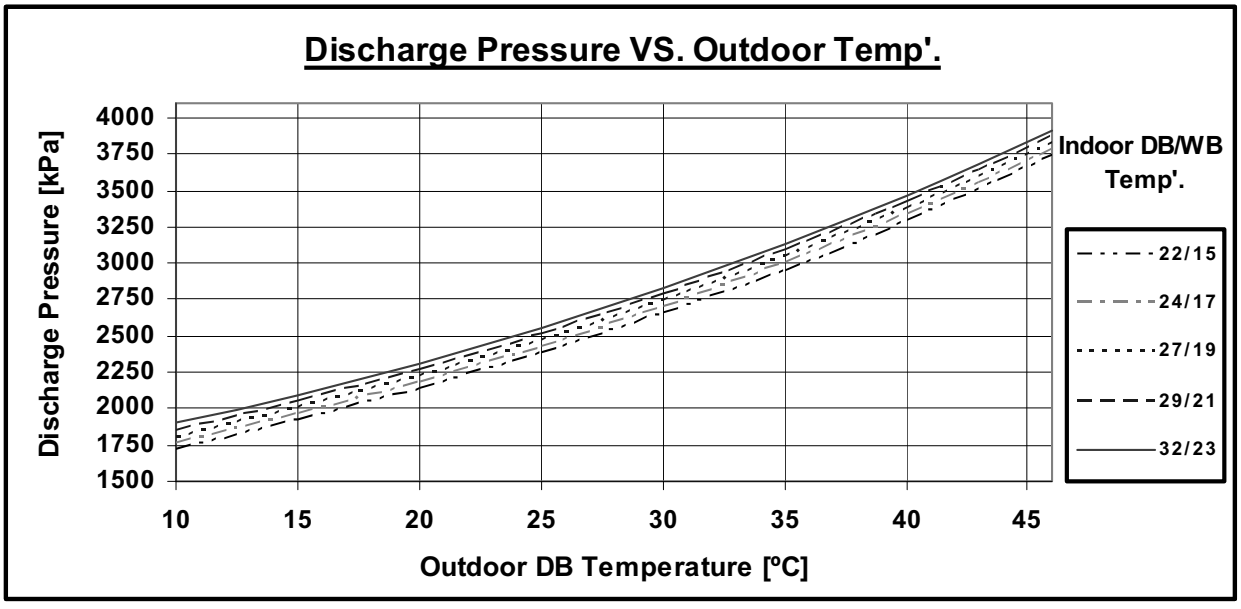


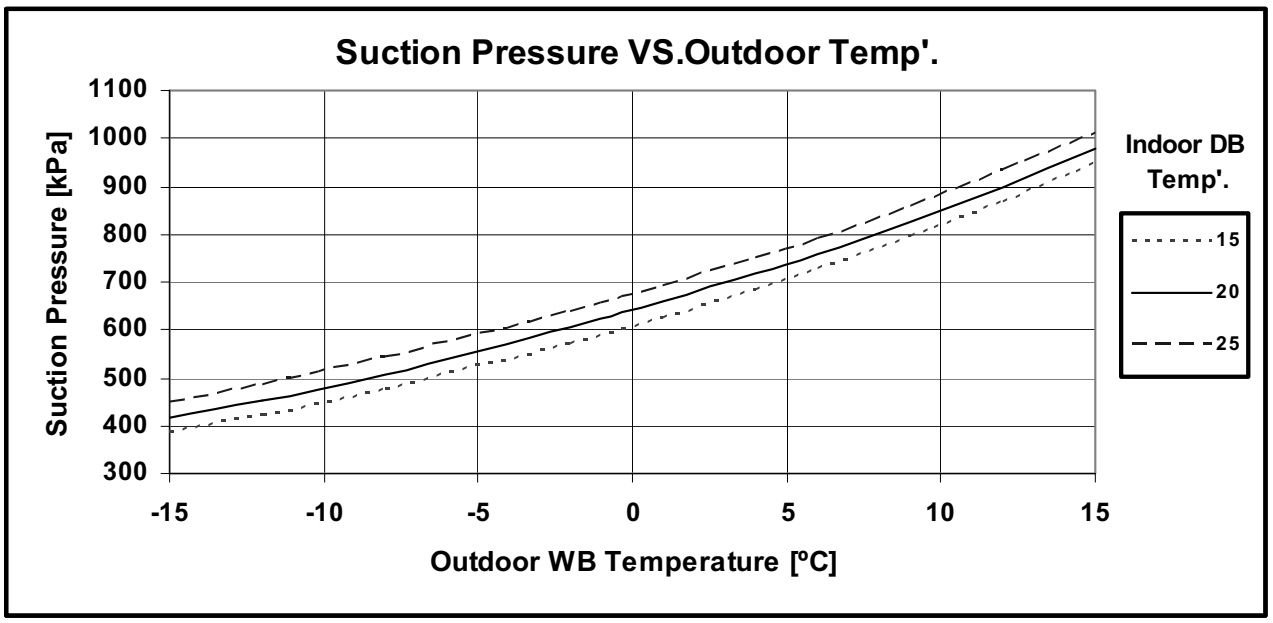
## 6.2 Model: Delta 25+35 DUO 38 DCI

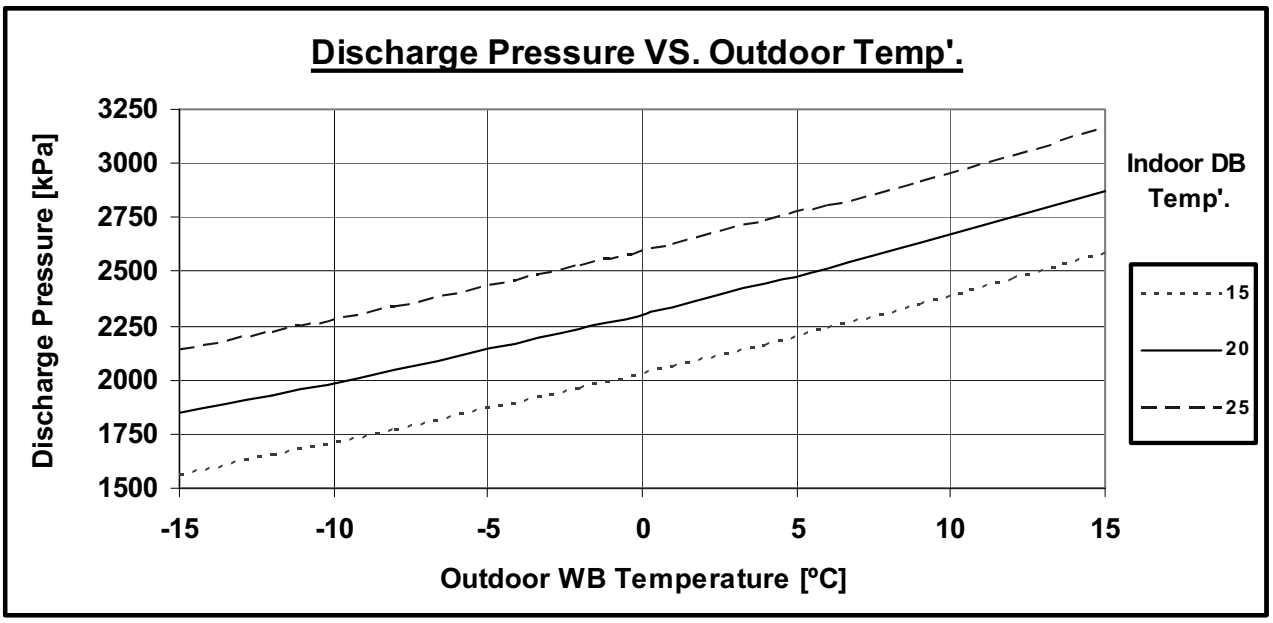
### 6.2.1 Cooling – Test Mode



### 6.1.2 Heading – Test Mode



# 7. ELECTRICAL DATA

| | |
|---|---|
| Power Supply | 1 PH, 220-240 VAC, 50Hz |
| Connected to | Outdoor |
| Maximum Current | 13.7 A |
| Inrush Current | 35 A |
| Starting Current | 10 A |
| Circuit breaker | 16 A |
| Power supply wiring - No. x cross section | 3 X 2.5 $mm^2$ |
| Interconnecting cable - No. x cross section | 2 X 4 X 1.5 $mm^2$ |

Note:

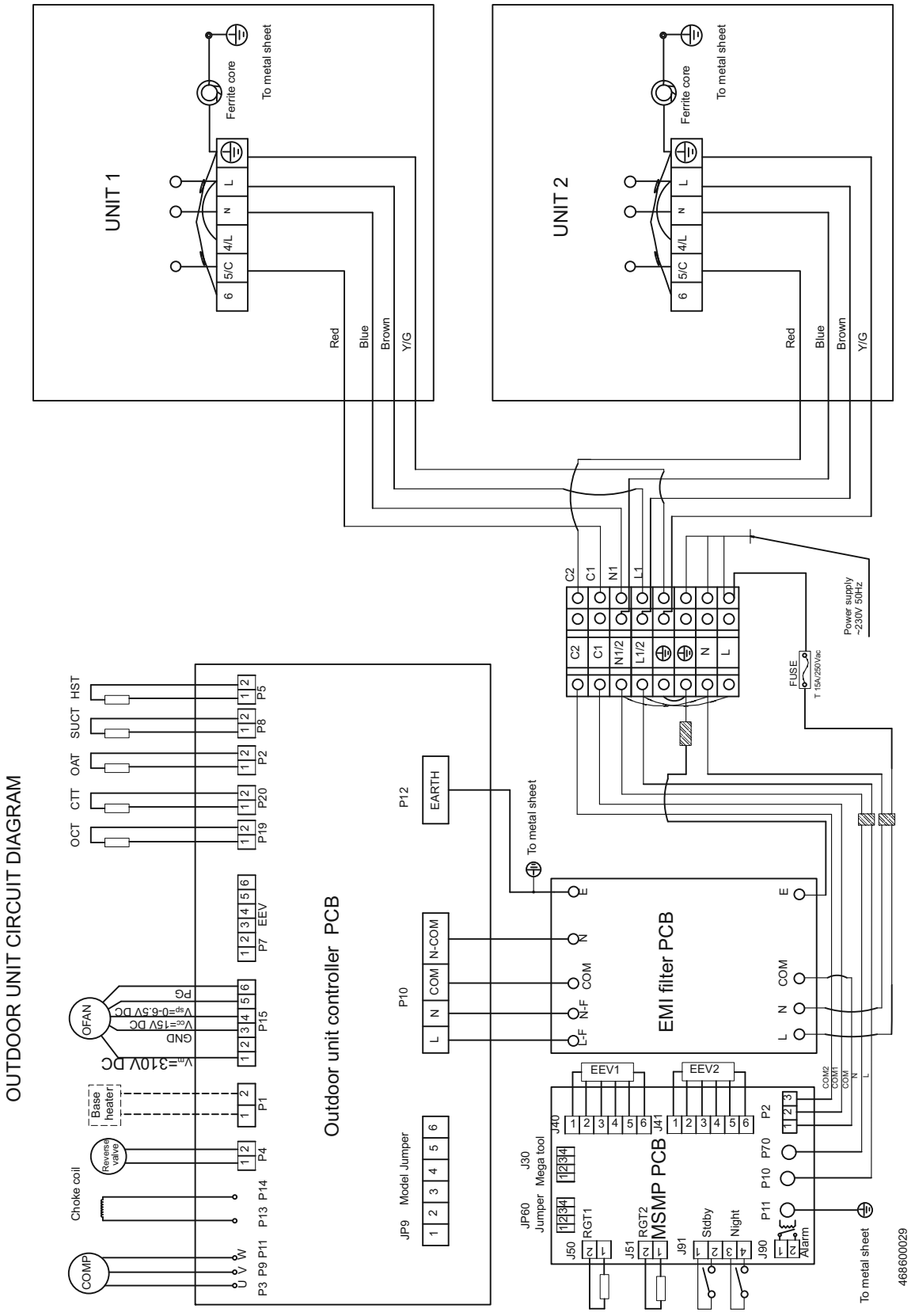
- Inrush current is the current when power is up. (charging the DC capacitors at outdoor unit controller).
- Starting current is the current when starting the compressor

***NOTE***

***Power wiring cord should comply with local lows and electrical regulations requirements.***

# 8. WIRING DIAGRAMS

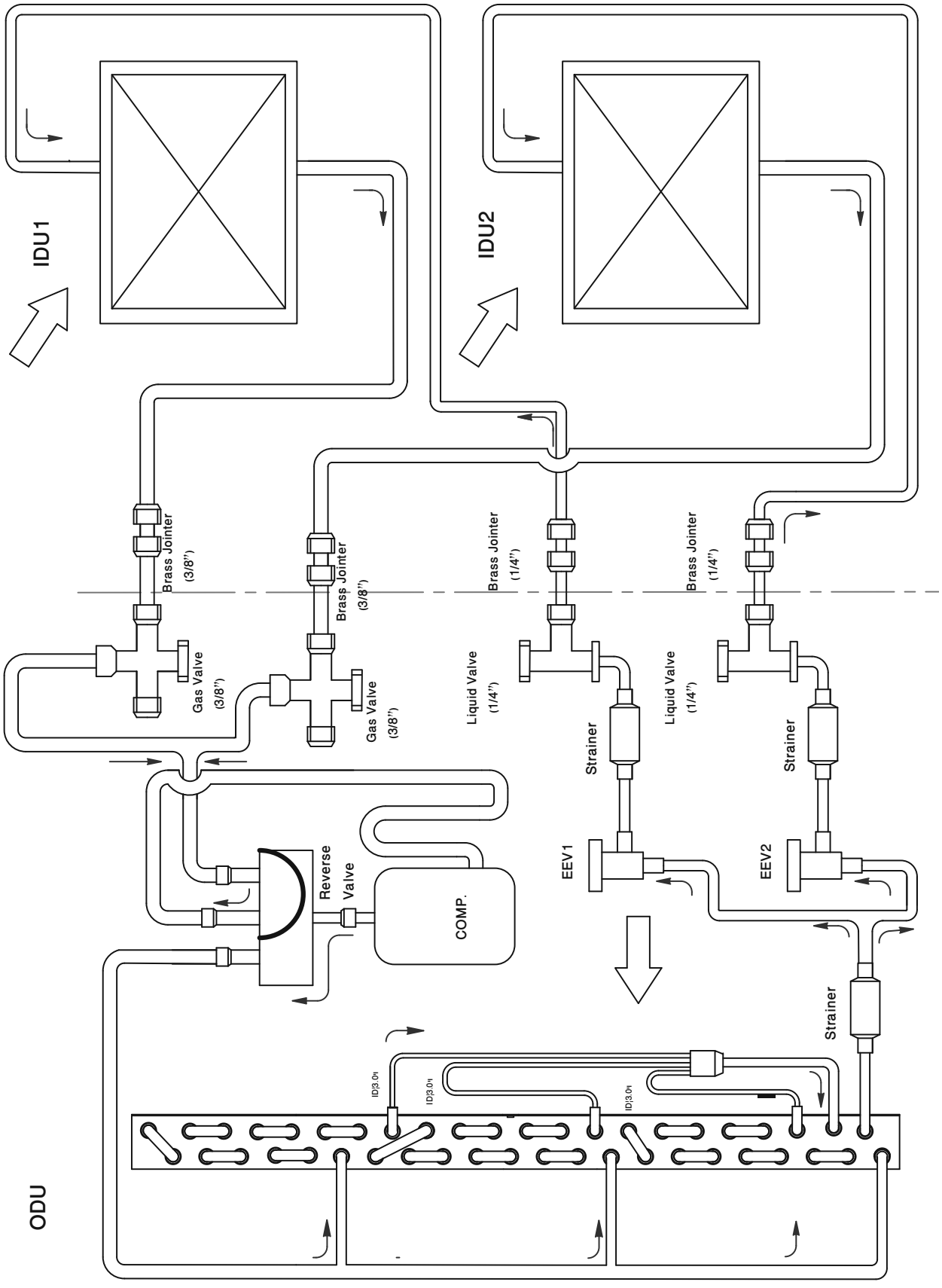
## 8.1 DUO 38 DCI / DELTA Wiring Diagram



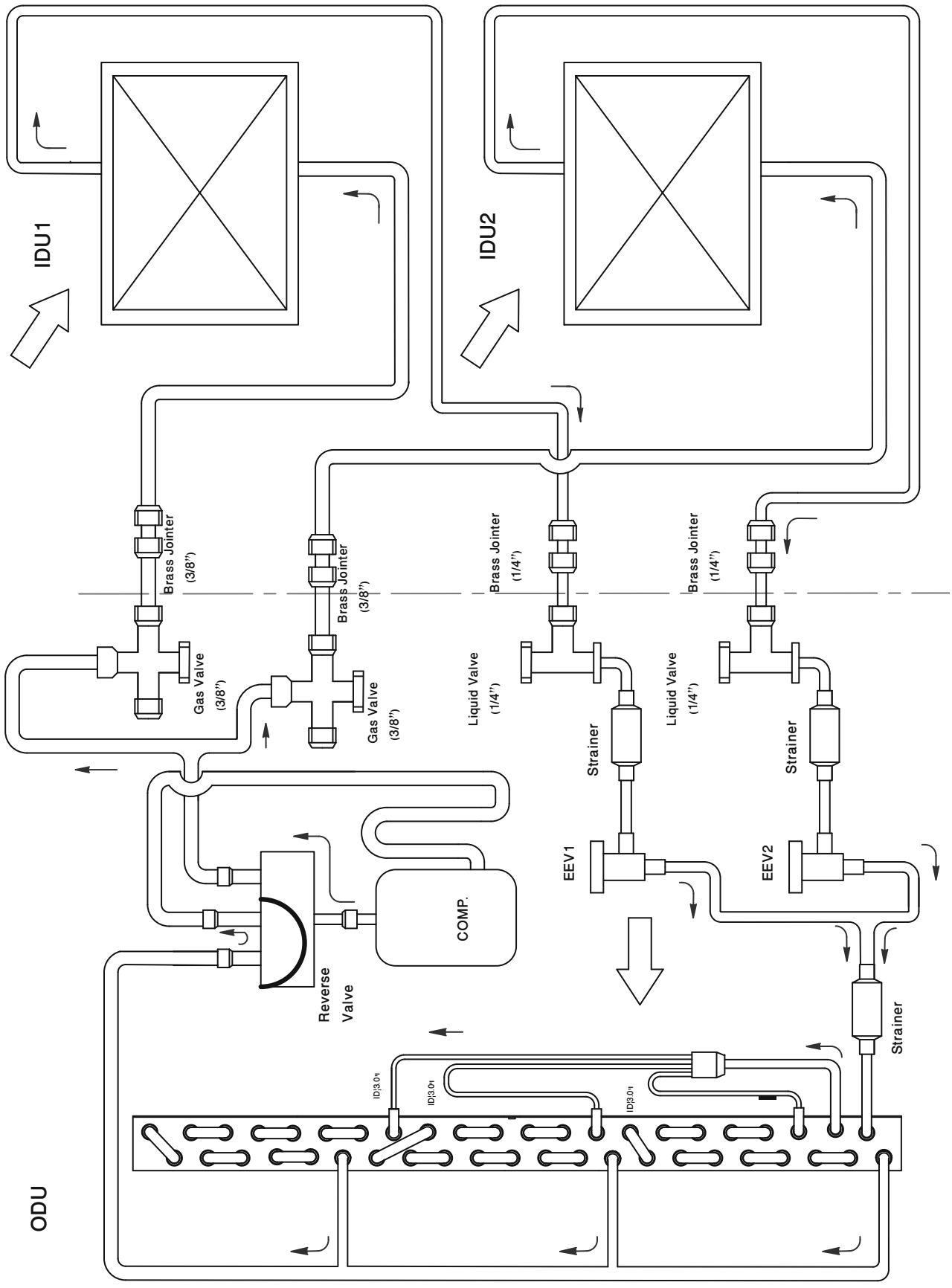
# 9. REFRIGERATION DIAGRAMS

## 9.1 Heat Pump Models

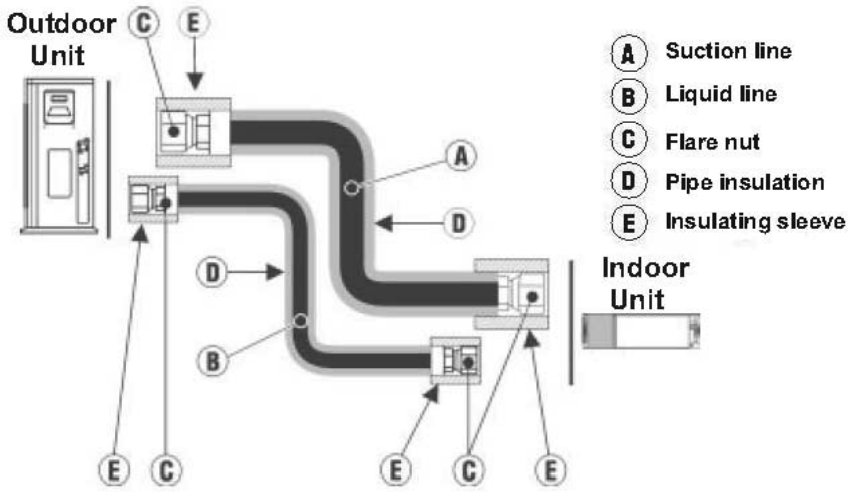
### 9.1.1 DUO 38 DCI => Cooling Mode

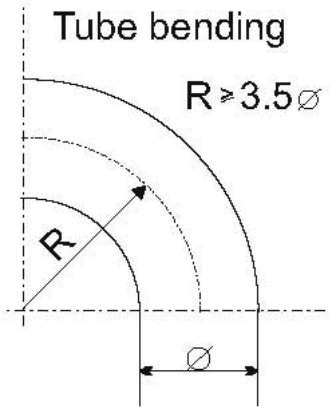


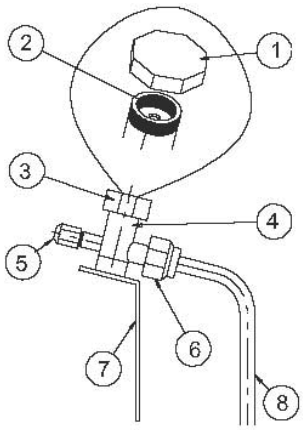
### 9.1.2 DUO 38 DCI => Heating Mode



# 10. TUBING CONNECTIONS



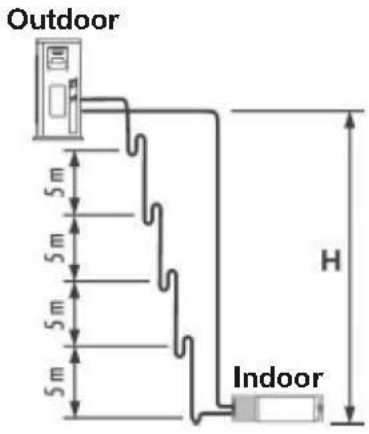




| TUBE (Inch) / TORQUE (Nm) | 1/4" | 3/8" | 1/2" | 5/8" | 3/4" |
|---|---|---|---|---|---|
| **Flare Nuts** | 11-13 | 40-45 | 60-65 | 70-75 | 80-85 |
| **Valve Cap** | 13-20 | 13-20 | 18-25 | 18-25 | 40-50 |
| **Service Port Cap** | 11-13 | 11-13 | 11-13 | 11-13 | 11-13 |

1. Valve Protection Cap-end
2. Refrigerant Valve Port (use Allen wrench to open/close)
3. Valve Protection Cap
4. Refrigerant Valve
5. Service Port Cap
6. Flare Nut
7. Unit Back Side
8. Copper Tube

When the outdoor unit is installed above the indoor unit an oil trap is required every 5m along the suction line at the lowest point of the riser. Incase the indoor unit is installed above the outdoor, no trap is required.



# 11. CONTROL SYSTEM

## 11.1 General Functions and Operating Rules (for single split models)

The DCI software is fully parametric.
All the model dependent parameters are shown in Blue color and with Italic style [*parameter*].
The parameters values are given in the last section of this control logic chapter of the service manual.

## 11.2 System Operation Concept

The control function is divided between indoor and outdoor unit controllers. Indoor unit is the system 'Master', requesting the outdoor unit for cooling/heating capacity supply. The outdoor unit is the system 'Slave' and it must supply the required capacity unless it enters into a protection mode avoiding it from supplying the requested capacity.

The capacity request is transferred via indoor to outdoor communication, and is represented by a parameter called 'NLOAD'. NLOAD is an integer number with values between 0 and 127, and it represents the heat or cool load felt by the indoor unit.

## 11.3 Compressor Frequency Control

### 11.3.1 NLOAD setting

The NLOAD setting is done by the indoor unit controller, based on a PI control scheme. The actual NLOAD to be sent to the outdoor unit controller is based on the preliminary LOAD calculation, the indoor fan speed, and the power shedding function.

NLOAD limits as a function of indoor fan speed:

| Indoor Fan Speed | Maximum NLOAD Cooling | Maximum NLOAD Heating |
|---|---|---|
| Low | *Max NLOADIF1C* | 127 |
| Medium | *Max NLOADIF2C* | 127 |
| High | *Max NLOADIF3C* | 127 |
| Turbo | *Max NLOADIF4C* | 127 |
| Auto | *Max NLOADIF5C* | 127 |

NLOAD limits as a function of power shedding:

| Mode | Power Shedding OFF | Power Shedding ON |
|---|---|---|
| Cool | No limit | Nominal Cooling |
| Heat | No limit | Nominal Heating |

### 11.3.2 Target Frequency Setting

The compressor target frequency is a function of the NLOAD number sent from the indoor controller and the outdoor air temperature.
Basic Target Frequency Setting:

| NLOAD | Target Frequency |
|---|---|
| 127 | *Maximum frequency* |
| 10 < NLOAD < 127 | Interpolated value between minimum and maximum frequency |
| 10 | *Minimum frequency* |
| 0 | Compressor is stopped |

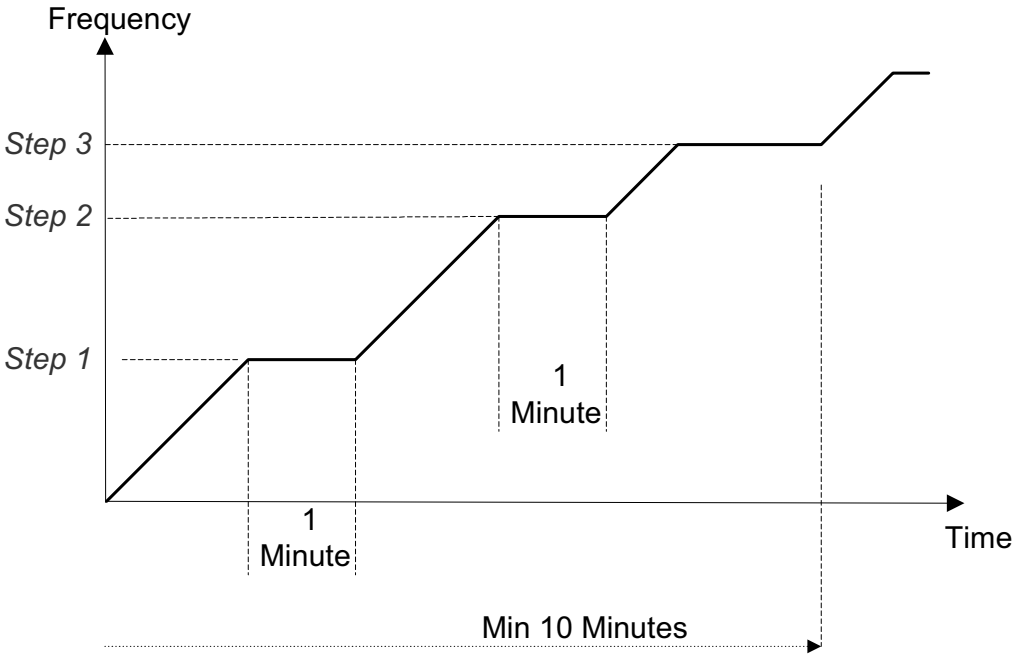
Target frequency limits as a function of outdoor air temperature (OAT):

| OAT Range | Cool mode limits | Heat mode limits |
|---|---|---|
| OAT < 6 | *MaxFreqAsOATC* | No limit |
| 6 ≤ OAT < 15 | | *MaxFreqAsOAT1H* |
| 15 ≤ OAT < 24 | | *MaxFreqAsOAT2H* |
| 24 ≤ OAT | No limit | |

### 11.3.3 Frequency Changes Control

**Frequency change rate is 1 Hz/sec.**

### 11.3.4 Compressor Starting Control




\

### 11.3.5 Minimum On and Off Time 3 minutes

## 11.4 Indoor Fan Control

10 Indoor fan speeds are determined for each model. 5 speeds for cool/dry/fan modes and 5 speeds for heat mode.
When user sets the indoor fan speed to a fixed speed (Low/ Medium/ High), unit will operate constantly at set speed.
When Auto Fan is selected, indoor unit controller can operate in all speeds. The actual speed is set according to the cool/heat load.

### 11.4.1 Turbo Speed

The Turbo speed is activated during the first 30 minutes of unit operation when auto fan speed is selected and under the following conditions:

- Difference between set point and actual room temperature is bigger then 3 degrees.
- Room temperature > 22 for cooling, or < 25 for heating.

## 11.5 Heating Element Control

Heating element can be started if LOAD > 0.8 * MaximumNLOAD AND Indoor Coil temperature < 45.
The heating element will be stopped when LOAD < 0.5 * MaximumNLOAD OR if Indoor Coil temperature > 50.

## 11.6 Outdoor Fan Control

7 outdoor fan speeds are determined for each model. 3 speeds for cool and dry modes, and 3 speeds for heat mode, and a very low speed.
Outdoor fan speed is a function of compressor frequency and outdoor air temperature (OAT).
4 routines for fan control are determined. The control routine selection depends on operation mode, compressor speed, and outdoor air temperature (OAT) and heat sink temperature (HST).

| Routine | Conditions |
|---|---|
| A | Heating with OAT < $15^0$C<br>or<br>Cooling with OAT > $20^0$C, or HST > $50^0$C<br>or<br>Faulty OAT |
| B | Cooling with $20^0$C > OAT > $7^0$C |
| C | Cooling with $7^0$C > OAT |
| D | Heating with OAT > $15^0$C |

| Compressor Frequency (CF) | Outdoor Fan Speed | | | |
|---|---|---|---|---|
| | Routine A | Routine B | Routine C | Routine D |
| CF = 0 | OFF | OFF | OFF | OFF |
| 10 ≤ CF < *OFLowFreq* | Low | Low | Very Low | Low |
| *OFLowFreq* ≤ CF < *OFMedFreq* | Medium | Low | Very Low | Low |
| *OFMedFreq* ≤ CF | High | Low | Low | Medium |

When compressor is switched to OFF and the heat sink temperature is above 55 degrees, the outdoor fan will remain ON in low speed for up to 3 minutes.

## 11.7 EEV (electronic Expansion valve) Control

EEV opening is defined as EEV = $EEV_{OL}$ + $EEV_{CV}$

- $EEV_{OL}$ is the initial EEV opening as a function of the compressor frequency, operation mode, unit model and capacity.
- $EEV_{CV}$ is a correction value for the EEV opening that is based on the compressor temperature.
- During the first 10 minutes of compressor operation $EEV_{CV}$ = 0.
- Once the first 10 minutes are over, the correction value is calculated as follow: $EEV_{CV}(n)$ = $EEV_{CV}(n-1)$ + $EEV_{CTT}$
- $EEV_{CTT}$ is the correction based on the compressor temperature. A target compressor temperature is set depending on frequency and outdoor air temperature, and the actual compressor temperature is compared to the target temperature to set the required correction to the EEV opening.

## 11.8 Reversing Valve (RV) Control

Reversing valve is on in heat mode.
Switching of RV state is done only after compressor is off for over 3 minutes.

## 11.9 Ionizer Control

Ionizer is on when unit is on AND indoor fan is on AND Ionizer power switch (on Ionizer) is on.

## 11.10 Electro Static Filter (ESF) Control

ESF is on when ESF switch is on, Safety switch is pressed, unit is on, AND indoor fan is on.

## 11.11 Base Heater Control

When OAT is connected, Base Heater will be on when unit is in heating and OAT<2$^0$C.
When OAT is disconnected, Base Heater will be on when unit is in heating.

## 11.12 Fan Mode

In high/ medium/ low indoor fan user setting, unit will operate fan in selected speed.
In Auto Fan user setting, fan speed will be adjusted automatically according to the difference between actual room temperature and user set point temperature.

## 11.13 Cool Mode

NLOAD is calculated according to the difference between actual room temperature and user set point temperature by PI control.
In high/ medium/ low indoor fan user setting, unit will operate fan in selected speed.
In Auto Fan user setting, fan speed will be adjusted automatically according to the calculated NLOAD.

## 11.14 Heat Mode

NLOAD is calculated according to the difference between actual room temperature and user set point temperature by PI control.
In high/ medium/ low indoor fan user setting, unit will operate fan in selected speed.
In AutoFan user setting, fan speed will be adjusted automatically according to the calculated NLOAD.

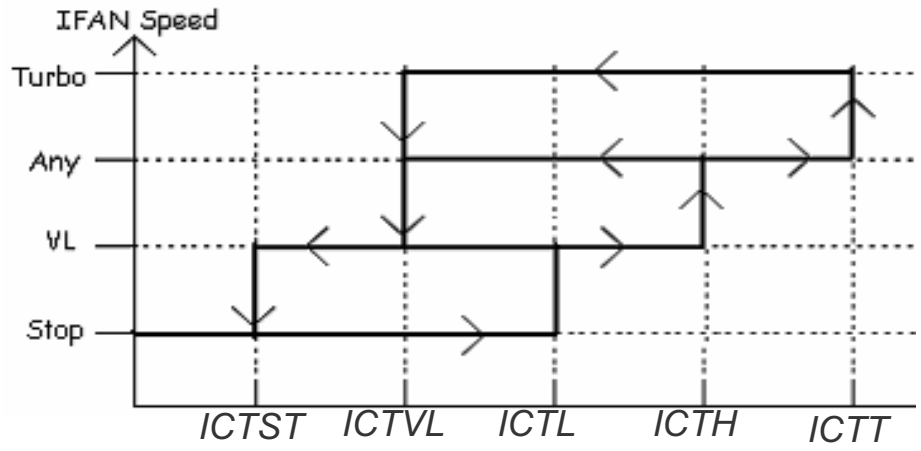
### 11.14.1 Temperature Compensation

In wall mounted, ducted, and cassette models, 3 degrees are reduced from room temperature reading (except when in I-Feel mode), to compensate for temperature difference between high and low areas in the heated room, and for coil heat radiation on room thermistor.
The temperature compensation can be enabled/disabled by shortening of J2 on the indoor unit controller.

| Model | J2 Shorted | J2 Opened |
|---|---|---|
| Wall mounted | Compensation Disabled | Compensation Enabled |
| Cassette | Compensation Enabled | Compensation Disabled |
| Ducted | Compensation Enabled | Compensation Disabled |
| Floor/Ceiling | Compensation Disabled | Compensation Enabled |

### 11.14.2 Indoor Fan Control in Heat Mode

Indoor fan speed depends on the indoor coil temperature:




## 11.15 Auto Cool/Heat Mode

When in auto cool heat mode unit will automatically select between cool and heat mode according to the difference between actual room temperature and user set point temperature (ΔT).
Unit will switch from cool to heat when compressor is off for 3 minutes, and ΔT < -3.
Unit will switch from heat to cool when compressor is off for 5 minutes, and ΔT < -3.

## 11.16 Dry Mode

As long as room temperature is higher then the set point, indoor fan will work in low speed and compressor will work between 0 and *MaxNLOADIF1C* Hz.
When the room temperature is lower than the set point, compressor will be switched OFF and indoor fan will cycle 3 minutes OFF, 1 minute ON.

## 11.17 Protections

There are 5 protection codes.
Normal (Norm) – unit operate normally.
Stop Rise (SR) – compressor frequency can not be raised but does not have to be decreased.
HzDown1 (D1) – Compressor frequency is reduced by 2 to 5 Hz per minute.
HzDown2 (D2) – Compressor frequency is reduced by 5 to 10 Hz per minute.
Stop Compressor (SC) – Compressor is stopped.

### 11.17.1 Indoor Coil Defrost Protection

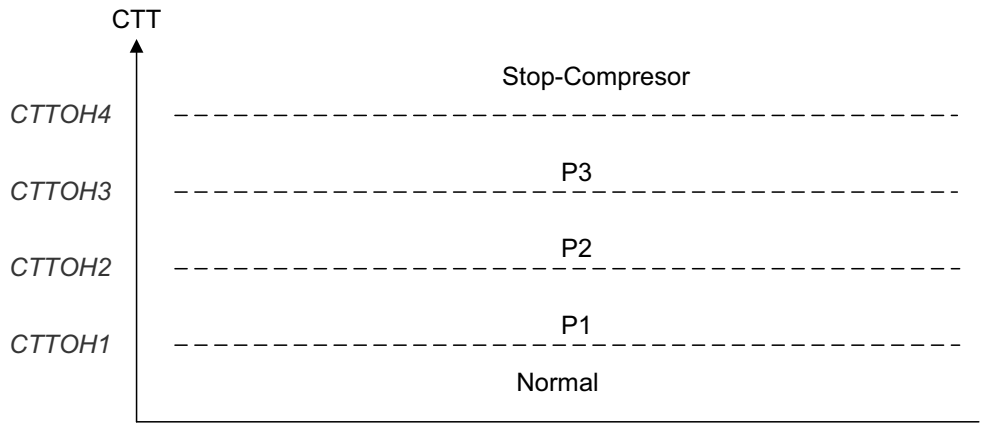
| ICT | ICT Trend | | | | |
|---|---|---|---|---|---|
| | Fast Increasing | Increasing | No change | Decreasing | Fast Decreasing |
| ICT < -2 | SC | SC | SC | SC | SC |
| -2 ≤ ICT < 0 | D1 | D1 | D2 | D2 | D2 |
| 0 ≤ ICT < 2 | SR | SR | D1 | D2 | D2 |
| 2 ≤ ICT < 4 | SR | SR | SR | D1 | D2 |
| 4 ≤ ICT < 6 | Norm | Norm | SR | SR | D1 |
| 6 ≤ ICT < 8 | Norm | Norm | Norm | SR | SR |
| 8 ≤ ICT | Normal | | | | |

### 11.17.2 Indoor Coil over Heating Protection

| ICT | ICT Trend | | | | |
|---|---|---|---|---|---|
| | Fast Decreasing | Decreasing | No Change | Increasing | Fast Increasing |
| ICT > 55 | SC | SC | SC | SC | SC |
| 53 < ICT ≤ 55 | D1 | D1 | D2 | D2 | D2 |
| 49 < ICT ≤ 53 | SR | SR | D1 | D2 | D2 |
| 47 < ICT ≤ 49 | SR | SR | SR | D1 | D2 |
| 45 < ICT ≤ 47 | Norm | Norm | SR | SR | D1 |
| 43 < ICT ≤ 45 | Norm | Norm | Norm | SR | SR |
| ICT ≤ 43 | Normal | | | | |

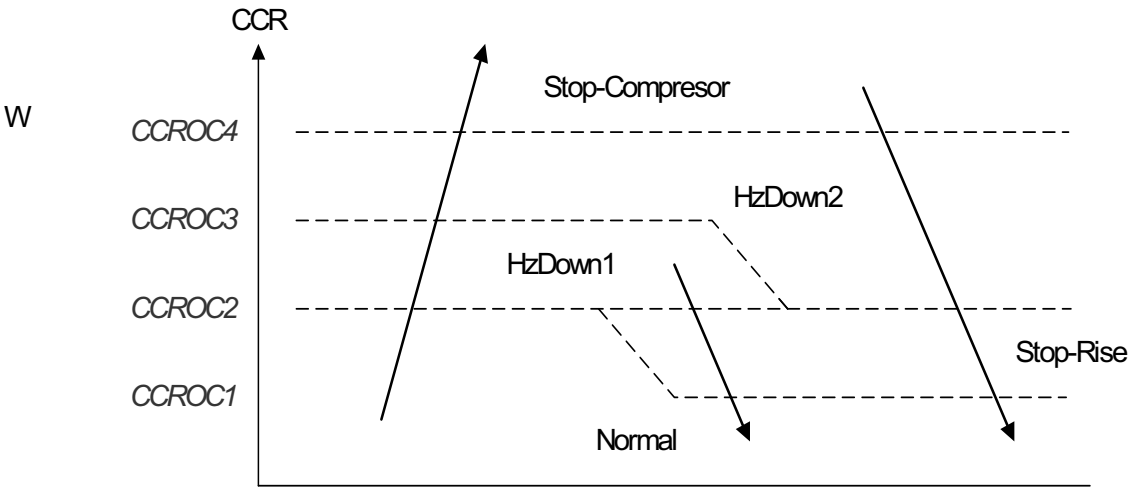
### 11.17.3 Compressor over Heating Protection

Compressor temperature can be in one of 5 control zones (4 in protection, and 1 normal), t.




| Control Status | Compressor Temperature Increases | Else |
|---|---|---|
| P1 | Norm | SR |
| P2 | D1 | SR |
| P3 | D2 | D1 |
| Stop Compressor | SC | |

### 11.17.4 Compressor over Current Protection



### 11.17.5 Heat Sink Over Heating Protection (NA for DCI 25 and 35)

| HST | HST Trend | | |
|---|---|---|---|
| | Decreasing | No Change | Increasing |
| HST > 90 | SC | SC | SC |
| 85 < HST ≤ 90 | D1 | D2 | D2 |
| 82 < HST ≤ 85 | SR | D1 | D2 |
| 80 < HST ≤ 82 | SR | SR | D1 |
| 78 < HST ≤ 80 | Norm | Norm | SR |
| HST ≤ 78 | Normal | | |

## 11.17.6 Outdoor Coil Deicing Protection

#### 11.17.6.1 Deicing Starting Conditions

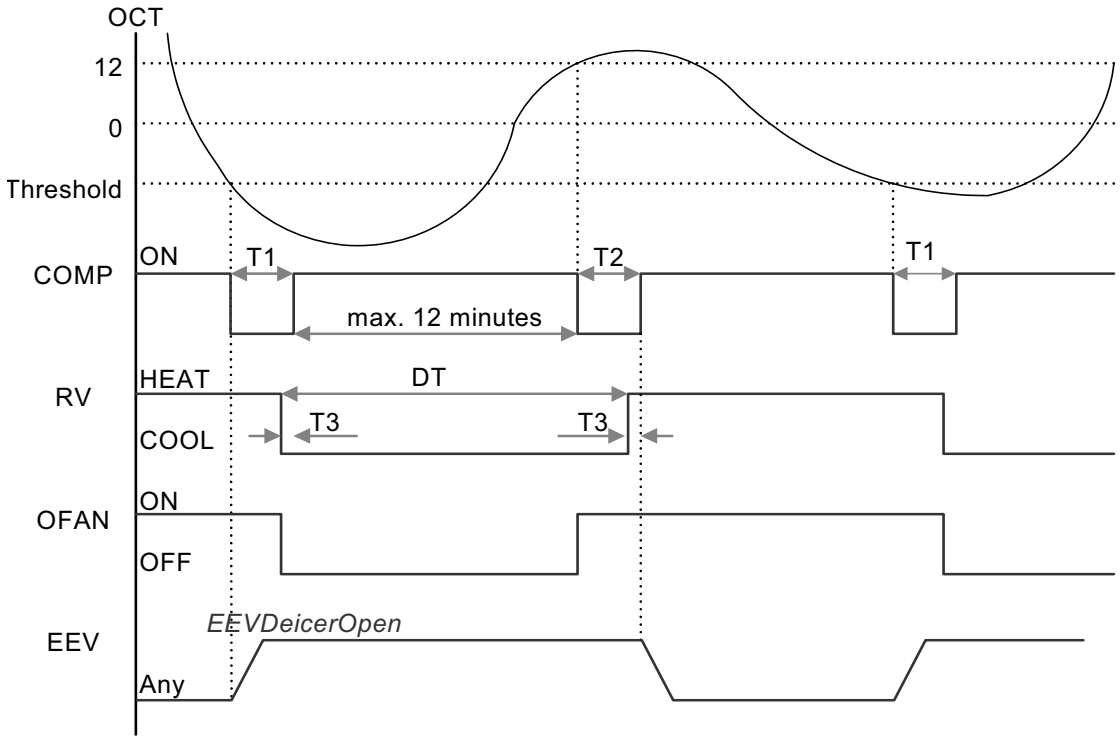
Deicing operation will start when either one of the following conditions exist:

- Case 1: OCT < OAT – 8 AND TLD > DI
- Case 2: OCT < OAT – 12 AND TLD > 30 minutes.
- Case 3: OCT is Invalid AND TLD > DI
- Case 4: Unit is just switched to STBY AND OCT < OAT – 8
- Case 5: NLOAD = 0 AND OCT < OAT -8

OCT – Outdoor Coil Temperature
OAT – Outdoor Air Temperature
TLD – Time from Last Deicing
DI – Deicing Interval (Time Interval between Two Deicing)

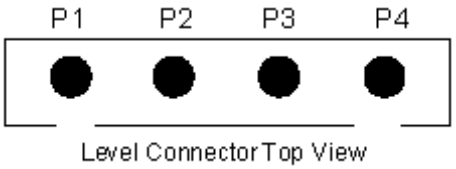
Deicing interval time when compressor is first started in heat mode, is 10 minutes if OCT < -2, and is 40 minutes in other cases.
Deicing interval time is changed (increased/ decreased in 10 minutes steps) as a function of deicing time. If deicing time is shorter then former deicing time, the deicing interval time will be increased. If deicing time is longer then former deicing time, the deicing interval time will be decreased.

#### 11.17.6.2 Deicing Protection Procedure




T1 = T2 = 36 seconds, T3 = 6 seconds

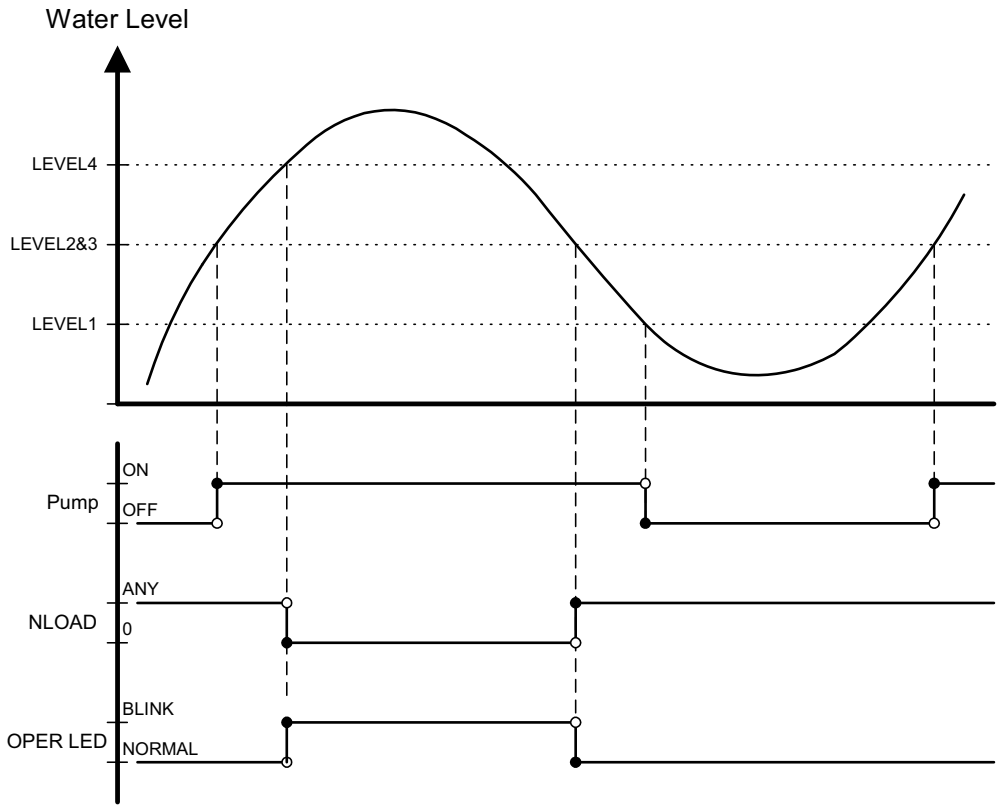
## 11.17.7 Condensate Water Over Flow Protection




Each of the pins P1, P2, P3 can have two options:
1 – When it is shorted with P4
0 – When it is not shorted to P4

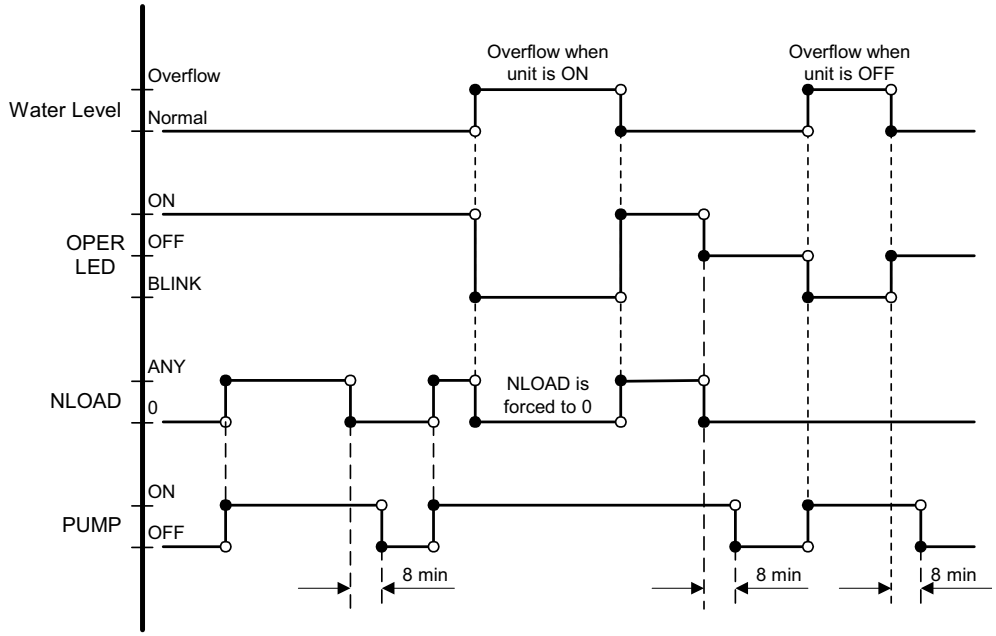
#### 11.17.7.1 Levels Logic (used in floor/ceiling models)

| P2 | P3 | Level |
|---|---|---|
| 0 | 0 | L0 |
| 1 | 0 | L1 |
| 1 | 1 | L2&3 |
| 0 | 1 | L4 |




### 11.17.7.2 1 Level Logic (used in all models except for floor/ceiling models)

| P2 | P3 | Level |
|---|---|---|
| Don't care | 1 | Normal |
| Don't care | 0 | Overflow |



## 11.18 Indoor Unit Dry Contact

**Indoor unit Dry contact has two alternative functions that are selected by J8.**

| Function | | Contact = Open | Contact = Short |
|---|---|---|---|
| J8 = Open | Presence Detector Connection | No Limit | Forced to STBY |
| J8 = Short | Power Shedding Function | No Limit | Limit NLOAD |

## 11.19 Operating the Unit from the Mode Button

Forced operation allows starting, stopping and operating in Cooling or Heating, in pre-set temperature according to the following table:

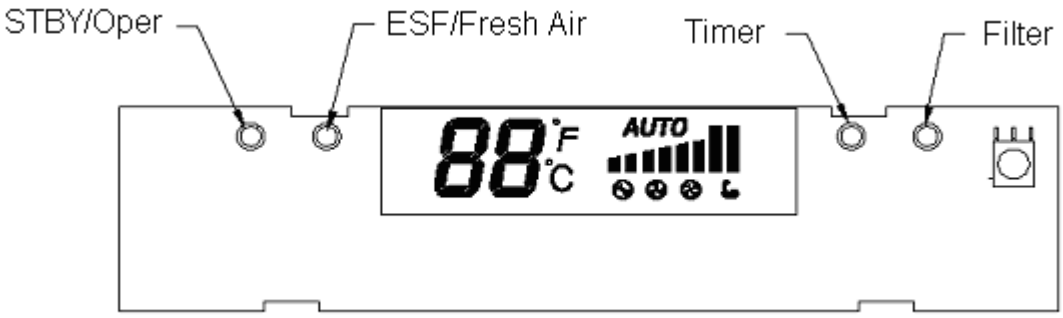
| Forced operation Mode | Pre-set Temperature |
|---|---|
| Cooling | $20^0$C |
| Heating | $28^0$C |

## 11.20 On Unit Controls and Indicators

### 11.20.1 Indoor Unit Controller Controls and Indicators for All Models Except for Floor/Ceiling model

| | |
|---|---|
| **STAND BY INDICATOR** | 1. Lights up when the Air Conditioner is connected to power and ready to receive the R/C commands |
| **OPERATION INDICATOR** | 1. Lights up during operation.<br>2. Blinks for 300 msec., to announce that a R/C infrared signal has been received and stored.<br>3. Blinks continuously during protections (according to the relevant spec section). |
| **TIMER INDICATOR** | Lights up during Timer and Sleep operation. |
| **FILTER INDICATOR** | Lights up when Air Filter needs to be cleaned. |
| **COOLING INDICATOR** | Lights up when system is switched to Cool Mode by using the Mode Switch on the unit. |
| **HEATING INDICATOR** | Lights up when system is switched Heat Mode by using the Mode Switch on the unit. |
| **Mode SWITCH (COOL/HEAT/OFF)** | Every short pressing , the next operation mode is selected, in this order : SB → Cool Mode → Heat Mode → SB → …<br>In long pressing system enters diagnostic mode. |
| **RESET / FILTER SWITCH** | For short pressing:<br>When Filter LED is on - turn off the FILTER INDICATOR after a clean filter has been reinstalled.<br>When Filter LED is off – enable/disable the buzzer announcer, if selected. |

### 11.20.2 Indoor Unit Controls and Indicators for LCD Display




| | STBY | Cool | Heat | Auto | Fan | Dry |
|---|---|---|---|---|---|---|
| 88 | OFF | SPT(1*) | SPT(1*) | SPT(1*) | SPT(1*) | SPT(1*) |
| °C | OFF(2*) | ON(2*) | ON(2*) | ON(2*) | ON(2*) | ON(2*) |
| °F | OFF(2*) | OFF(2*) | OFF(2*) | OFF(2*) | OFF(2*) | OFF(2*) |
| **(Low)** | OFF | User setting IFAN speed | User setting IFAN speed | User setting IFAN speed | User setting IFAN speed | User setting IFAN speed |
| **(Med)** | OFF | | | | | |
| **(High)** | OFF | | | | | |
| **(Turbo)** | OFF | | | | | |
| AUTO **(Auto)** | OFF | | | | | |
| **Backlight(red)** | OFF | OFF | ON(3*) | ON(3*) | ON(3*) | OFF |
| **Backlight(green)** | OFF | ON(3*) | OFF | ON(3*) | ON(3*) | ON(3*) |

### 11.20.3 Outdoor Unit Controller Indicators

Unit has three LED's.
SB LED is ON when power is ON (230 VAC, even when no communication).
STATUS LED is ON when COMP is ON, and Blinks according to diagnostics mode definitions when either fault or protection occurs.
FAULT LED Blinks according to diagnostics mode definitions when either fault or protection occurs.

## 11.21 Jumper Settings

### 11.21.1 Indoor Unit Controller

0 = Open Jumper (disconnect jumper).
1 = Close Jumper (connect jumper).
Self test Jumper – J1

| OPERATION | J1 |
|---|---|
| SELF-TEST | 1 |
| NORMAL | 0 |

**Compensation Jumper – J2**

| Model | J2 (Default) | Compensation |
|---|---|---|
| Wall Mounted | 0 | Activated |
| Floor/Ceiling | 1 | Deactivated |
| Ducted/cassette | 1 | Activated |

**Family selection Jumper – J3, J4 and J5**

| Family | J5 | J4 | J3 |
|---|---|---|---|
| Reserved | 0 | 0 | 0 |
| Reserved | 0 | 0 | 1 |
| Reserved | 0 | 1 | 0 |
| Wall Mounted (WNG/FLO) | 0 | 1 | 1 |
| Floor/Ceiling (PXD) | 1 | 0 | 0 |
| Reserved | 1 | 0 | 1 |
| Ducted (LS) | 1 | 1 | 0 |
| Cassette (K) | 1 | 1 | 1 |

| IDU Model | Jumper Setting | | | | | |
|---|---|---|---|---|---|---|
| | J8 | J7 | J6 | J5 | J4 | J3 |
| WNG25 | 0 | 0 | 0 | 0 | 1 | 1 |
| WNG35 | 0 | 1 | 0 | 0 | 1 | 1 |
| WNG50 | 0 | 0 | 1 | 0 | 0 | 0 |
| WNG60 | 0 | 1 | 1 | 0 | 0 | 0 |
| WNG80 | 0 | 0 | 1 | 0 | 0 | 1 |
| PXD25 | 0 | 0 | 0 | 1 | 0 | 0 |
| PXD35 | 0 | 1 | 0 | 1 | 0 | 0 |
| PXD50 | 1 | 0 | 0 | 1 | 0 | 0 |
| K25 | 0 | 0 | 0 | 1 | 1 | 1 |
| K35 | 0 | 1 | 0 | 1 | 1 | 1 |
| K50 | 1 | 0 | 0 | 1 | 1 | 1 |
| LS35 | 0 | 1 | 0 | 1 | 1 | 0 |

For wall mounted units Jumpers j7, j8 can be configured by service. All other jumpers on the above table are factory default (cannot be changed by service).
For unit types as Cassettes, floor ceiling, and ducted, jumpers are set by a model plug.

**Model selection Jumper – J6, J7**

| Model | J7 | J6 |
|---|---|---|
| 9000 Btu/hr | 0 | 0 |
| 12000 Btu/hr | 0 | 1 |
| 18000 Btu/hr | 1 | 0 |
| 24000 Btu/hr | 1 | 1 |

**J8- Clock/Power Shedding**

| Operation | J8 |
|---|---|
| Clock | 0 |
| Power Shedding | 1 |

**J9 – IFAN Cycling Disabling**

| Display Mode (wall mounted units only) | J9 |
|---|---|
| LCD | 0 |
| LED | 1 |

### 11.21.2 Outdoor Unit Controller

#### 11.21.2.1 JP9 JUMPER LAYOUT

| | | | | |
|---|---|---|---|---|
| **Reserved** (PIN 9) | **ODU3** (PIN 7) | **ODU2** (PIN 5) | **ODU1** (PIN 3) | **ODU0** (PIN 1) |
| **GND** (PIN 10) | **GND** (PIN 8) | **GND** (PIN 6) | **GND** (PIN 4) | **GND** (PIN 2) |

### 11.21.3 ODU MODEL SELECTION

| ODU3 | ODU2 | ODU1 | ODU0 | ODU Model |
|---|---|---|---|---|
| OFF | OFF | OFF | OFF | Reserved |
| OFF | OFF | OFF | ON (PIN1 & PIN2) | A (DCI 25) |
| OFF | OFF | ON (PIN3 & PIN4) | OFF | B (DCI 35) |
| OFF | OFF | ON (PIN3 & PIN4) | ON (PIN1 & PIN2) | C (DCI 50) |
| OFF | ON (PIN5 & PIN6) | OFF | OFF | D |
| OFF | ON (PIN5 & PIN6) | OFF | ON (PIN1 & PIN2) | E (Duo) |
| OFF | ON (PIN5 & PIN6) | ON (PIN3 & PIN4) | OFF | F |
| OFF | ON (PIN5 & PIN6) | ON (PIN3 & PIN4) | ON (PIN1 & PIN2) | G |
| ON (PIN7 & PIN8) | OFF | OFF | OFF | H |
| ON (PIN7 & PIN8) | OFF | OFF | ON (PIN1 & PIN2) | I |
| ON (PIN7 & PIN8) | OFF | ON (PIN3 & PIN4) | OFF | J |
| ON (PIN7 & PIN8) | OFF | ON (PIN3 & PIN4) | ON (PIN1 & PIN2) | K |
| ON (PIN7 & PIN8) | ON (PIN5 & PIN6) | OFF | OFF | L |
| ON (PIN7 & PIN8) | ON (PIN5 & PIN6) | OFF | ON (PIN1 & PIN2) | M |
| ON (PIN7 & PIN8) | ON (PIN5 & PIN6) | ON (PIN3 & PIN4) | OFF | N |
| ON (PIN7 & PIN8) | ON (PIN5 & PIN6) | ON (PIN3 & PIN4) | ON (PIN1 & PIN2) | O |

## 11.22 Test Mode

### 11.22.1 Entering Test Mode

System can enter Test mode in two ways:

- Automatically when the following conditions exists for 30 minutes continuously:
  - Mode = Cool, Set point = 16, Room temperature = 27±1, Outdoor temperature = 35±1

Or

  - Mode = Heat, Set point = 30, Room temperature = 20±1, Outdoor temperature = 7±1
- Manually when entering diagnostics with the following settings:
  - Mode = Cool, Set point = 16
  - Mode = Heat, Set point = 30

### 11.22.2 Unit Operation in Test Mode

In test mode, the unit will operate in fixed settings according to the indoor fan speed setting :

| Indoor Fan Speed Setting | Unit Setting |
|---|---|
| Low | Minimum Capacity Setting |
| High | Nominal Capacity Setting |
| Auto | Maximum Capacity Setting |

During test mode, protections are disabled, except for stop compressor status.

## 11.23 Additional Functions and Operating Rules (for DUAL split models)

The DCI SW is fully parametric.
All the model dependent parameters are shown in Blue color and with Italic style [*parameter*].
The parameters values are given in the last section of this control logic chapter of the service manual.

### 11.23.1 System Control Concept

All indoor unit related items control remains the same as in single split applications.
All outdoor unit related control logic remains the same as in single split applications.
The MSMP controller is responsible only for the following control:

- Setting of system operation mode (cool/heat)
- Setting the NLOAD for the outdoor units
- Controlling of the EEV's
- Dry contacts control

### 11.23.2 Compressor Frequency Control

### 11.23.3 Outdoor Unit NLOAD setting

The MSMP controller gets the NLOAD from each of the indoor units, and sends a combined NLOAD to the outdoor unit control. The combined NLOAD is a weighted average of the indoor units NLOAD.
The weight of the indoor units as a function of their nominal capacity:

| Indoor Unit Capacity [kW] (kBtu/hr) | Capacity Code |
|---|---|
| 2.5 (9000) | 1 |
| 3.5 (12000) | 1.5 |
| 5.0 (18000) | 2 |
| 7.2 (24000) | 3 |

### 11.23.4 EEV (electronic Expansion valve) Control

EEV opening is defined as EEV = $EEV_{OL}$ + $EEV_{CV}$

- $EEV_{OL}$ is the initial EEV opening as a function of the compressor frequency, operation mode, unit model and capacity.
- $EEV_{CV}$ is a correction value for the EEV opening that is based in cooling mode on the relevant indoor unit super heat and compressor temperature.
- During the first 10 minutes of compressor operation $EEV_{CV}$ = 0.

### 11.23.5 System Mode Setting and Reversing Valve (RV) Control

The first indoor unit that is causing the system to be turned ON sets the system mode.

### 11.23.6 Indoor Units Operation when Indoor Unit Mode is Different than Outdoor Unit Mode

- Open louvers according to user selection.
- Indoor fan is forced to OFF.

## 11.24 Dry Contacts Control

| Dry Contact | Contact = Open | Contact = Short |
|---|---|---|
| STBY | No Limit | System is Forced to STBY |
| Night | No Limit | Outdoor fan speed reduced to low in cooling mode |

A dry contact output for Alarm will be shorted when any failure exists in the system.

## 11.25 SW Parameters

### 11.25.1 Indoor Units SW Parameters

General Parameters for All Models:

**Parameters defining the indoor fan speed as a function of Indoor Coil temperature in heat mode (ICT):**

| | | |
|---|---|---|
| ICTST Speed | ICT to stop indoor fan | 25 |
| ICTVLSpeed | ICT to go down to very low speed | 28 |
| ICTLSpeed | ICT to start in very low speed | 30 |
| ICTHSpeed | ICT to start in increase speed from very low | 32 |
| ICTTSpeed | ICT to enable Turbo fan speed | 40 |

Model Depended Parameters:

| Parameter name | Wall Mounted Models | |
|---|---|---|
| | DCI 25 | DCI 35 |
| **NLOAD limits as a function of selected indoor fan speed** | | |
| MaxNLOADIF1C | 40 | 40 |
| MaxNLOADIF2C | 53 | 53 |
| MaxNLOADIF3C | 120 | 120 |
| MaxNLOADIF4C | 127 | 127 |
| MaxNLOADIF5C | 127 | 127 |
| **Indoor Fan speeds** | | |
| IFVLOWC | 700 | 700 |
| IFLOWC | 800 | 800 |
| IFMEDC | 900 | 950 |
| IFHIGHC | 1050 | 1100 |
| IFTURBOC | 1150 | 1200 |
| IFVLOWH | 700 | 700 |
| IFLOWH | 800 | 850 |
| IFMEDH | 950 | 1000 |
| IFHIGHH | 1100 | 1150 |
| IFTURBOH | 1200 | 1250 |
| **Nominal Compressor Frequency** | | |
| NomLoadC | 40 | 62 |
| NomLoadH | 55 | 67 |

| Parameter Name | Cassette Models | | | |
|---|---|---|---|---|
| | K 25 | K 35 | K 35S | K 50 |
| **NLOAD limits as a function of selected indoor fan speed** | | | | |
| MaxNLOADIF1C | 40 | 40 | 40 | 40 |
| MaxNLOADIF2C | 53 | 56 | 56 | 60 |
| MaxNLOADIF3C | 120 | 90 | 90 | 90 |
| MaxNLOADIF4C | 127 | 90 | 90 | 90 |
| MaxNLOADIF5C | 127 | 90 | 90 | 90 |
| **Nominal Compressor Frequency** | | | | |
| NomLoadC | 40 | 60 | 56 | 63 |
| NomLoadH | 55 | 69 | 73 | 80 |

### 11.25.2 Outdoor Units SW Parameters:

| Parameter Name | DCI25 | DCI35 | DCI 50 | DCI50 DUO |
|---|---|---|---|---|
| **Compressor Parameters** | | | | |
| MinFreqC | 30 | 33 | 20 | 20 |
| MaxFreqC | 64 | 80 | 85 | 97 |
| MinFreqH | 30 | 35 | 20 | 26 |
| MaxFreqH | 81 | 93 | 99 | 106 |
| Step1Freq | 60 | 60 | 60 | 60 |
| Step2Freq | 70 | 70 | 70 | 80 |
| Step3Freq | 90 | 90 | 90 | 90 |
| **Frequency limits as a function of outdoor air temperature** | | | | |
| MaxFreqAsOATC | 50 | 50 | 64 | 62 |
| MaxFreqAsOAT1H | 65 | 75 | 85 | 85 |
| MaxFreqAsOAT2H | 60 | 60 | 60 | 60 |
| **Compressor Over Heating Protection** | | | | |
| CTTOH1 | 94 | 94 | 94 | 90 |
| CTTOH2 | 98 | 98 | 98 | 95 |
| CTTOH3 | 102 | 102 | 102 | 102 |
| CTTOH4 | 105 | 105 | 105 | 105 |
| **Compressor Over Current Protection [A]** | | | | |
| CCR01 | 7.1 | 7.1 | 10 | 10 |
| CCR02 | 7.5 | 7.5 | 10.5 | 10.5 |
| CCR03 | 7.9 | 7.9 | 10.8 | 10.8 |
| CCR04 | 8.3 | 8.3 | 11.2 | 11.2 |
| **Outdoor Fan Speed (RPM)** | | | | |
| VL | 200 | 200 | 200 | 200 |
| OFLOWC | 550 | 550 | 600 | 600 |
| OFMEDC | 700 | 700 | 760 | 830 |
| OFMAXC | 830 | 830 | 920 | 920 |
| OFLOWH | 550 | 550 | 600 | 600 |
| OFMEDH | 700 | 700 | 830 | 920 |
| OFMAXH | 830 | 830 | 1000 | 1000 |
| **Outdoor Fan Limit Control** | | | | |
| OFLowFreq | 45 | 45 | 40 | 40 |
| OFMedFreq | 57 | 57 | 70 | 70 |

# 12. TROUBLESHOOTING

**WARNING!!!**

When Power Up – the whole outdoor unit controller, including the wiring, is under HIGH VOLTAGE!!!

Never open the Outdoor unit before turning off the Power!!!

When turned off, the system is still charged (400V)!!!

It takes about 3 Min. to discharge the system.

Touching the controller before discharging may cause an electrical shock!!!

**For safe handling of the controller please refer to section 1.6 below.**

## 1.1 Dual Split System Failures and Corrective Actions

| No | SYMPTOM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|---|
| 1 | Power supply indicator at indoor unit (Red LED) does not light up. | No power supply | Check power supply from the outdoor. If power supply is OK, check display and display wiring. If OK, replace controller. |
| 2 | Indoor fan does not start (louvers are opened and Green LED does light up) | Unit in heat mode and coil is still not warm. | Change to cool mode and check. |
| | | The outdoor unit is in the opposite mode. | Change operation mode and check if fan starts. |
| | | Problem with PCB or capacitor | Change to high speed and Check power supply to motor is higher than 130VAC (for Triac controlled motor) or higher than 220VAC for fixed speed motors, if OK replace capacitor, if not OK replace controller |
| 3 | Compressor does not start | Jumper settings of outdoor unit is not correct | Use diagnostics (see 1.2 below) information on MSMP board. |
| 4 | One indoor is operating, in cool mode, with no capacity, and the other unit has water leaks/freezing problems | The communication wires of the two indoor units are switched | Check and correct the communication wires connection |
| 5 | One indoor is operating in heat mode with a limited capacity, and the coil on the other unit is very hot. | | |
| 6 | Compressor operate but unit generate no capacity | EEV is stuck in close position | Check EEV |
| 7 | One unit only is operating | Communication problems | Use diagnostics information on MSMP board (see 1.2 below). |
| 8 | All others | Specific problems of indoor or outdoor units | Use diagnostics information on MSMP board (see 1.2 below), and perform action items as recommended in single split systems |

## 1.2 Checking the refrigeration system

Checking system pressures and other thermodynamic measures should be done when system is in Test Mode (in Test mode, system operates in fixed settings). The performance curves given in this manual are given for unit performance in test mode when high indoor fan speed is selected.
Entering test mode:
Set the two indoor units to Cool/16 degrees/High indoor fan speed, or Heat/30 degrees/High indoor fan speed, and enter diagnostics. Note: the two indoor units should be set to the same mode and fan speed.

## 1.3 Judgment by MSMP Diagnostics

The MSMP controller has 11 LED's (1 STBY LED, 5 Unit LEDs and 5 Status/Fault LEDs).
STBY LED is ON when power is ON.
5 Unit LEDs refer to four Indoor units and one Outdoor unit. They will turn on one at a time and the corresponding Indoor/Outdoor unit status/fault code will be displayed on the Status/Fault LEDs. If the unit is normal (no fault), the unit LED and the corresponding status will be displayed for 5 seconds and move to the next unit LED. On the other hand, if the unit is in fault, the unit LED and the corresponding fault will be displayed for 10 seconds, and hence more time to read the fault code.

### 1.3.1 MSMP Fault Code for Outdoor unit:

| No | Problem | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | OCT is disconnected | 0 | 0 | 0 | 0 | 1 |
| 2 | OCT is shorted | 0 | 0 | 0 | 1 | 0 |
| 3 | CTT is disconnected | 0 | 0 | 0 | 1 | 1 |
| 4 | CTT is shorted | 0 | 0 | 1 | 0 | 0 |
| 5 | HST is disconnected (when enabled) | 0 | 0 | 1 | 0 | 1 |
| 6 | HST is shorted (when enabled) | 0 | 0 | 1 | 1 | 0 |
| 7 | OAT is disconnected (when enabled) | 0 | 0 | 1 | 1 | 1 |
| 8 | OAT is shorted (when enabled) | 0 | 1 | 0 | 0 | 0 |
| 9 | TSUC is disconnected (when enabled) | 0 | 1 | 0 | 0 | 1 |
| 10 | TSUC is shorted (when enabled) | 0 | 1 | 0 | 1 | 0 |
| 11 | IPM | 0 | 1 | 0 | 1 | 1 |
| 12 | Bad Outdoor unit EEPROM | 0 | 1 | 1 | 0 | 0 |
| 13 | DC under voltage | 0 | 1 | 1 | 0 | 1 |
| 14 | DC over voltage | 0 | 1 | 1 | 1 | 0 |
| 15 | AC under voltage | 0 | 1 | 1 | 1 | 1 |
| 16 | Indoor / Outdoor unit Communication mismatch | 1 | 0 | 0 | 0 | 0 |
| 17 | No Communication | 1 | 0 | 0 | 0 | 1 |
| 18 | Illegal Outdoor unit Model | 1 | 0 | 0 | 1 | 0 |
| 19 | Bad MSMP EEPROM | 1 | 0 | 0 | 1 | 1 |
| 20 | Heat sink Over Heating | 1 | 0 | 1 | 0 | 0 |
| 21 | Deicing | 1 | 0 | 1 | 0 | 1 |
| 22 | Compressor Over Heating | 1 | 0 | 1 | 1 | 0 |
| 23 | Compressor Over Current | 1 | 0 | 1 | 1 | 1 |
| …. | Reserved | | | | | |
| 27 | Bad Communication | 1 | 1 | 0 | 1 | 1 |
| … | Reserved | | | | | |
| 29 | No Fault (Heat Mode) | 1 | 1 | 1 | 0 | 1 |
| 30 | No Fault (Cool, Dry, Fan Mode) | 1 | 1 | 1 | 1 | 0 |
| 31 | No Fault (Stand By) | 1 | 1 | 1 | 1 | 1 |

### 1.3.2 Outdoor unit diagnosis by MSMP and corrective actions

| No. | Fault | Probable Cause | Corrective Action |
|---|---|---|---|
| 1 | Sensors failures of all types | | Check sensors connections or replace sensors. |
| 2 | IPM Fault | Electronics HW problem | Check all wiring and jumper settings, if OK, replace electronics. |
| 3 | Bad EEPROM | | No action, unless special parameters are required for unit operation. |
| 4 | DC under/over Voltage | Electronics HW problem | Check outdoor unit power supply voltage |
| 5 | AC under Voltage | | Check outdoor unit power supply voltage |
| 6 | Indoor / Outdoor unit Communication mismatch | Indoor and Outdoor controllers are with different versions | Replace Indoor controller |
| 7 | No Communication | Communication or grounding wiring is not good. | Check Indoor to Outdoor wiring and grounding |
| 8 | Compressor Lock | | Switch unit to STBY and restart |
| 9 | Bad Communication | Communication quality is low reliability | Check Indoor to Outdoor wiring and grounding |

### 1.3.3 MSMP Fault Code for Indoor unit:

| No | Problem | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | RT-1 is disconnected | 0 | 0 | 0 | 0 | 1 |
| 2 | RT-1 is shorted | 0 | 0 | 0 | 1 | 0 |
| 3 | RT-2 is disconnected | 0 | 0 | 0 | 1 | 1 |
| 4 | RT-2 is shorted | 0 | 0 | 1 | 0 | 0 |
| 5 | RGT is disconnected | 0 | 0 | 1 | 0 | 1 |
| 6 | Reserved | 0 | 0 | 1 | 1 | 0 |
| 7 | Communication mismatch | 0 | 0 | 1 | 1 | 1 |
| 8 | No Communication | 0 | 1 | 0 | 0 | 0 |
| 9 | No Encoder | 0 | 1 | 0 | 0 | 1 |
| 10 | Reserved | 0 | 1 | 0 | 1 | 0 |
| 11 | Outdoor unit fault | 0 | 1 | 0 | 1 | 1 |
| 12 | Reserved | 0 | 1 | 1 | 0 | 0 |
| 13 | Reserved. | 0 | 1 | 1 | 0 | 1 |
| 14 | Reserved | 0 | 1 | 1 | 1 | 0 |
| 15 | Reserved | 0 | 1 | 1 | 1 | 1 |
| 17 | Defrost protection | 1 | 0 | 0 | 0 | 1 |
| 18 | Deicing Protection | 1 | 0 | 0 | 1 | 0 |
| 19 | Outdoor Unit Protection | 1 | 0 | 0 | 1 | 1 |
| 20 | Indoor Coil HP Protection | 1 | 0 | 1 | 0 | 0 |
| 21 | Overflow Protection | 1 | 0 | 1 | 0 | 1 |
| 22 | Reserved | 1 | 0 | 1 | 1 | 0 |
| 23 | Reserved | 1 | 0 | 1 | 1 | 1 |
| 24 | EEPROM Not Updated | 1 | 1 | 0 | 0 | 0 |
| 25 | Bad EEPROM | 1 | 1 | 0 | 0 | 1 |
| 26 | Bad Communication | 1 | 1 | 0 | 1 | 0 |
| 27 | Using EEPROM data | 1 | 1 | 0 | 1 | 1 |
| 29 | No Fault (Heat Mode) | 1 | 1 | 1 | 0 | 1 |
| 30 | No Fault (Cool, Dry, Fan Mode) | 1 | 1 | 1 | 1 | 0 |
| 31 | No Fault (Stand By) | 1 | 1 | 1 | 1 | 1 |

### 1.3.4 Indoor unit diagnosis by MSMP and corrective actions

| No. | Fault | Probable Cause | Corrective Action |
|---|---|---|---|
| 1 | Sensors failures of all types | | Check sensors connections or replace sensors. |
| 2 | IPM Fault | Electronics HW problem | Check all wiring and jumper settings, if OK, replace electronics. |
| 3 | Bad EEPROM | | No action, unless special parameters are required for unit operation. |
| 4 | DC under/over Voltage | Electronics HW problem | Check outdoor unit power supply voltage |
| 5 | AC under Voltage | | Check outdoor unit power supply voltage |
| 6 | Indoor / Outdoor unit Communication mismatch | Indoor and Outdoor controllers are with different versions | Replace Indoor controller |
| 7 | No Communication | Communication or grounding wiring is not good. | Check Indoor to Outdoor wiring and grounding |
| 8 | Compressor Lock | | Switch unit to STBY and restart |
| 9 | Bad Communication | Communication quality is low reliability | Check Indoor to Outdoor wiring and grounding |

## 1.4 Judgment by MegaTool

MegaTool is a special tool to monitor the system states.
Using MegaTool requires:

- A computer with RS232C port.
- A connection wire for MegaTool.
- A special MegaTool software.

Use MegaTool according to following procedure:

- Setup MegaTool software: copy the software to the computer.
- Connect RS232C port in computer with MegaTool port in Indoor/Outdoor unit controller by the connection wire.
- Run the software and choose the COM port, you can monitor the A/C system state in monitor tab.

## 1.5 Simple procedures for checking the Main Parts

### 1.5.1 Checking Mains Voltage.

Confirm that the Mains voltage is between 198 and 264 VAC. If Mains voltage is out of this range, abnormal operation of the system is expected. If in range check the Power (Circuit) Breaker and look for broken or loosed cable lugs or wiring mistake(s).

### 1.5.2 Checking Power Input.

If Indoor unit power LED is unlighted, power down the system and check the fuse of the Indoor unit. If the fuse is OK replace the Indoor unit controller. If the fuse has blown, replace the fuse and power up again.
Checking Power Input procedure for the Outdoor unit is the same as with the Indoor unit.

#### 1.5.3 Checking the PCB.

Appearance inspect: Check discoloration, nick and connection of copper foil, short-circuit and open circuit, component soldering, bulgy and distortion of electrolytic capacitor.
Power circuit check: check voltage of every power level (5V, 12V, 15V) printed on back of PCB.

#### 1.5.4 Checking the Outdoor Fan Motor.

Enter Test Mode (where the OFAN speed is high)
Check the voltage between lead wires according to the normal value as following:

- Between red wire and black wire: 310VDC +/- 20V
- Between orange wire and black wire: 15VDC +/- 1V
- Between yellow wire and black wire: 2-6VDC

#### 1.5.5 Checking the Compressor.

The compressor is brushless permanence magnetic DC motor. Three coil resistances are THE same. Check the resistance between three poles.

#### 1.5.6 Checking the Reverse Valve (RV).

Running in heating mode, check the voltage between two pins of reverse valve connector, normal voltage is 220VAC.

#### 1.5.7 Checking the electrical expansion valve (EEV).

The EEV has two parts, drive part and valve. The drive part is a step motor; it is ringed on the valve. Check the drive voltage (12VDC). When Outdoor unit is power on, EEV shall run and have click and vibration.

### 1.6 Precaution, Advise and Notice Items

#### 1.6.1 High voltage in Outdoor unit controller.

Whole controller, including the wires, connected to the Outdoor unit controller may have the potential hazard voltage when power is on. Touching the Outdoor unit controller may cause an electrical shock.
**Advise:** Don't touch the naked lead wire and don't insert finger, conductor or anything else into the controller when power is on.

#### 1.6.2 Charged Capacitors

Three large-capacity electrolytic capacitors are used in the Outdoor unit controller. Therefore, charging voltage (380VDC) remains after power down. Discharging takes about three minutes after turned off. Touching the Outdoor unit controller before discharging may cause an electrical shock. When open the Outdoor unit controller cover, don't touch the soldering pin by hand or by any conductive material.
**Advise:** 1. Open the Outdoor unit controller cover only after five minutes from power down.
2. Measure the electrolytic capacitors voltage before farther checking controller for safety.

#### 1.6.3 Additional advises

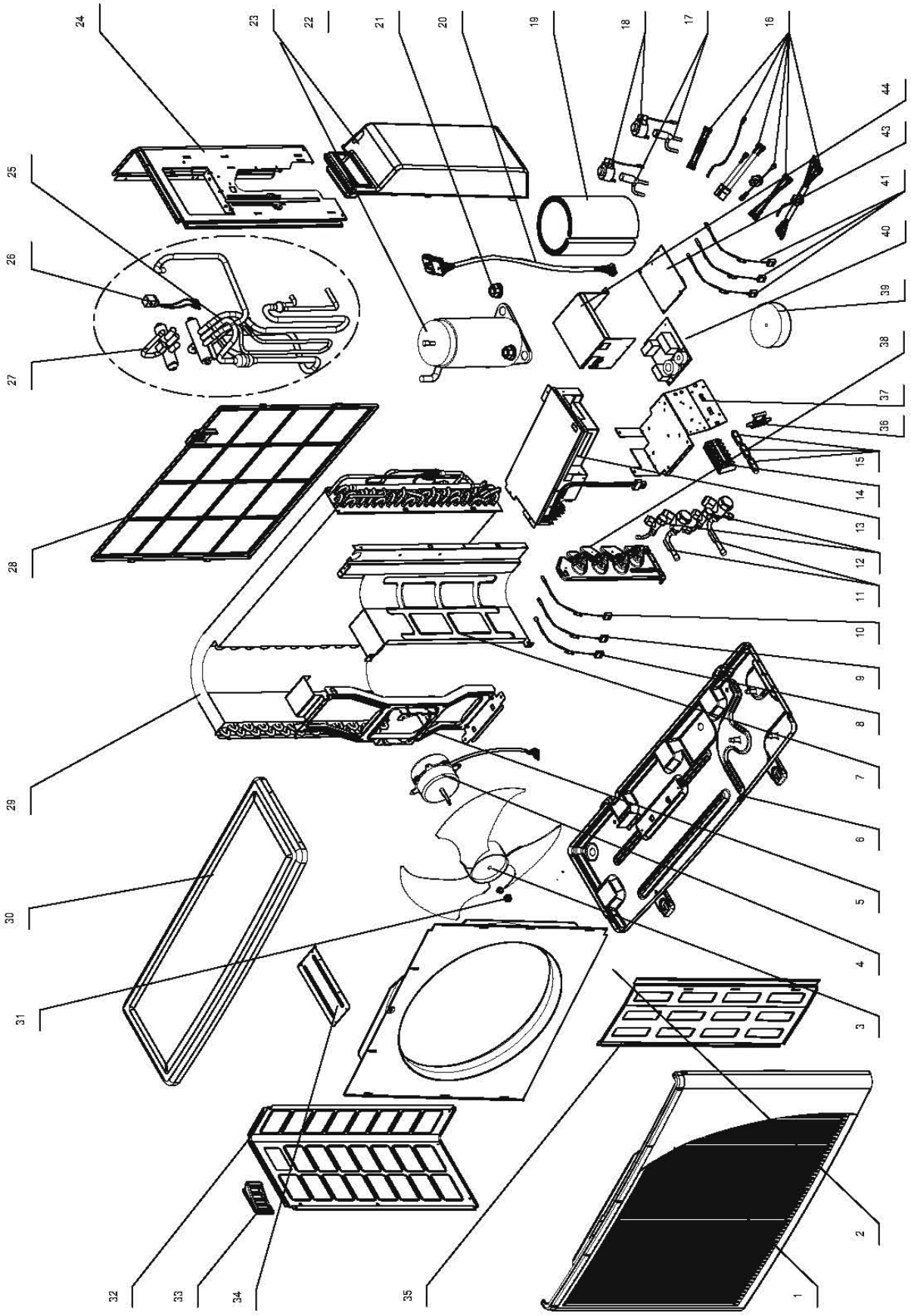
When disassemble the controller or the front panel, turn off the power supply.

When connecting or disconnecting the connectors on the PCB, hold the whole housing, don't pull the wire.

There are sharp fringes and sting on shell. Use gloves when disassemble the A/C units.

# 13. EXPLODED VIEWS AND SPARE PARTS LISTS

## 13.1 Outdoor Unit: DUO 38 DCI / DELTA



## 13.2 Outdoor Unit: DUO 38 DCI / DELTA

| No. | Part No. | Description |
|---|---|---|
| 1 | 433218 | Front Panel A |
| 2 | 4526340 | Air inlet ring-420 |
| 3 | 4526476 | Axial fan OD=401 |
| 4 | 4526475 | Resin Motor |
| 5 | 433215 | Motor Support |
| 6 | 464600021 | Base Painting Assy. |
| 7 | 4526403 | Partition |
| 8 | 4526774 | Outdoor air thermistor(OAT) |
| 9 | 4526775 | Compressor top thermistor(CTT) |
| 10 | 4526776 | Outdoor coil thermistor(OCT) |
| 11 | 452630201 | 3/8" Gas Valve(R410A) |
| | 452630200 | 3/8" Gas Valve(R410A) |
| 12 | 4526301 | 1/4" Liqiud Valve(R410A) |
| 13 | 4526403 | OUTDOOR DC INVERTER CONTROLLER |
| 14 | 4527130 | terminal block |
| 15 | 204107 | Cable clip Nylon |
| 16 | 4526225 | Power lead wire |
| | 4526968 | Grounding wire with magnetic ring |
| | 4526223 | AC-IN wire |
| | 4526222 | Fuse connected wire |
| | 4526226 | Power lead wire |
| 17 | 4526827 | Electronical expansion valve |
| 18 | 452682802 | EEV coil CAM-MD12FKS-2□White connector, 530mm) |
| | 452682800 | EEV coil CAM-MD12FKS-1 (Red, 530mm) |
| 19 | 4526344 | Comp. Insulation1 |
| 20 | 4510677 | Nut With Flange M8 |
| 21 | 4526221 | Compressor wire |
| 22 | 4526204 | Compressor Assy |
| 23 | 433230 | Valve Cover |
| 24 | 4526429 | Right side panel (painting plate) |
| 25 | 461600010 | 4way valve soldering assy |
| 26 | 4522509 | 4-Way valve coil |
| 27 | 4518951 | 4-W valve SHF-4H for R410A |
| 28 | 433228 | Back Side Net |
| 29 | 462000000 | condensor Soldering assy |
| 30 | 4519614 | Painting Top Cover |
| 31 | 4519300 | Nut M5 L |
| 32 | 433225 | Handle |
| 33 | 4519607 | Left Side Panel Painting Plate |
| 34 | 4526298 | Bridge |
| 35 | 433223 | Painting Insulation Plate |
| 36 | 4526219 | Fuse 6C(15A,230V)EHK:150-007-00 |
| 37 | 452823600 | Therminal sheet |
| 38 | 4526430 | Valve Support(painting plate) |
| 39 | 4526396 | Choke assy. 167-021-01 |
| 40 | 4526224 | EMI filter board 901-098-00 |
| 41 | 4526774 | Outdoor air thermistor(OAT) |
| | 4526776 | Outdoor coil thermistor(OCT) |
| | 4526970 | Suction tube Thermistor(SUT2) |
| | 452911100 | Sensor/ Suction3 |
| 43 | 4526227 | MSMP communcation board 906-002-00 |
| 44 | 452823600 | Terminal Plate Assy. |

# APPENDIX A

## INSTALLATION AND OPERATION MANUAL

► **INSTALLATION MANUAL DUO 38 DCI / DELTA**